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April 15, 1988

Energy Research Abstracts

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ENERGY RESEARCH ABSTRACTS

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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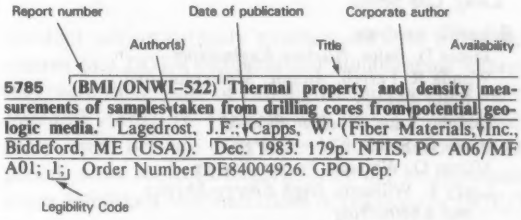
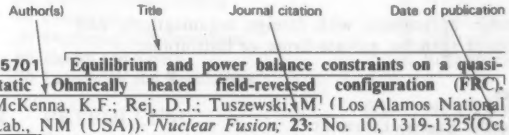
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; Order Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 **Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC).** McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23:** No. 10, 1319-1325 (Oct 1983).

Abstract

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
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• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
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Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
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Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70

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IEA Biomass Conversion Service
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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

13906 (NP—8751697) Basis of the process of coal conversion. Report 1984-1985. (Essen Univ. (Gesamthochschule) (Germany, F.R.). Sonderforschungsbereich 218 - Verfahrensgrundlagen der Kohleumwandlung). 1985. 145p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751697/JAW.

The special research area, which has existed at Essen University since January 1, 1984, has set itself the target of optimising coal conversion processes and the use of coal and making them environmentally more acceptable. This is done in collaboration with two institutes of the University of Bochum and of Bergbauforschung GmbH at Essen. The report submits promising results on the following subjects: investigations of changes of properties of coal during treatment; atomisation of coal suspensions; pyrolysis kinetics of hard coal; the effect of accompanying minerals on catalysts of coal gasification; combustion kinetics; the formation of nitrogen oxides in fluidized-bed combustion; emission during hard coal combustion and gasification; separation of dust in conversion processes; treatment of stack gas wash water.

0103 Preparation

REFER ALSO TO CITATION(S) 13925, 13970, 13976, 14005, 14024

13907 (CONF-870999—6) Ultrafine coal cleaning with metal salt solutions. Janikowski, S.K.; Skrobutt, A.T.; Vorres, K.S. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003044/JAW.

From 2. international processing and utilization of high-sulfur coal conference; Carbondale, IL, USA (28 Sep 1987).

The technical feasibility of a two step process to remove inorganic and organic sulfur as well as mineral matter from a high sulfur Illinois No. 6 coal was examined. Fine grinding of the coal to an average particle size of 2 microns followed by agglomeration with a light hydrocarbon reduced the mineral matter content from 16.2% to 2.8% (dry) and sulfur content from 6.5% to 3.0% (maf). Residual pyritic and organic sulfur in the ultrafine coal was 0.7% and 2.2%, respectively. Subsequent chemical treatment with aqueous $CuCl_2$ or $FeCl_3$ solutions under mild conditions further reduced the mineral matter and sulfur content. Residual sulfur removal increased with $CuCl_2$ concentration to a maximum of 26% under an oxygen head gas with a 23% organic sulfur reduction and 29% decrease in pyritic sulfur. Reactions with $FeCl_3$ reduced the pyritic sulfur by 100% although net increases in organic sulfur were observed. The ash content was additionally reduced to less than 1% for this salt system. Total sulfur and mineral matter removal varied up to 65% and 89%, respectively, for the $CuCl_2$ reactions, and 60% and 95% for reactions with $FeCl_3$. As sulfur removal increased, the heating value of the coal decreased. 19 refs., 4 figs., 2 tabs.

13908 (DOE/MC/10637—2414-Vol.3, pp 1-45, Paper 2) Advanced processes for slurry production: Annual technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March 1987. Maas, D.J.; Potas, T.A.; Malterer, T.J.; DeWall, R.A. Apr 1987. NTIS, PC A10/MF A01. Order Number DE87006533/JAW.

In Low-rank coal research: Volume 3, Combustion research: Final report.

A North Dakota lignite from the Coteau bed, Velva Mine, and a Wyoming subbituminous coal from the Adaville No. 1 bed, Kemmerer Mine, were both cleaned using gravity separation and froth flotation followed by acid leaching. The Velva lignite was cleaned from an ash content of 12.7 to 2.4 wt % with an 83 wt % yield, and the Kemmerer coal was cleaned from 3.7 to 0.9 wt % ash with a 97 wt % yield. In preliminary tests with a North Dakota lignite from the Beulah Mine, the lignite was cleaned from 9.2 to 1.4 wt % ash with an 89 wt % yield. Cleaning results verified the observations made in petrographic analyses, which showed that the Velva lignite should be micronized for best cleaning results and micronization should not be necessary to clean the Kemmerer subbituminous coal. Froth flotation worked well with Kemmerer and gave poor results with Velva. Raw samples of each coal were hydrothermally treated in a 2.5-ton/day process development unit (PDU) for slurry fuel preparation. Combining micronized hydrothermally treated (HT) Kemmerer coal with an HT coarse grind to approximate a bimodal particle distribution produced significant improvement in coal solids loadings. Sarpy Creek subbituminous coal was also HT in the PDU and then prepared, with and without limestone, for combustion testing in an ash fouling combustion furnace and in an atmospheric fluidized bed. The limestone, added for sulfur capture, lowered slurry viscosity slightly and reduced rheopectic behavior. Heat transfer coefficients determined for the Sarpy Creek coal/water slurries were compared to the coefficients from four other low-rank coals and were correlated to coal ash content. 15 refs., 14 figs., 17 tabs.

13909 (NP—8751693) Testing and optimisation of a novel type of discontinuous pressure belt filter (5 m/sup 2/ prototype) for dewatering fine-grained coal slurries. Final report. Holz, K. (Ruhrkohle A.G., Essen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1987. 92p. (In German). NTIS (US Sales Only), PC A05. Order Number DE88751693/JAW.

KHD-Humboldt-WEDAG AG developed the prototype of a discontinuously-working pressurized belt filter for intensified and more efficient dewatering of slimes. Within the project, this prototype was tested and was to be functionally optimized after mechanical improvements. In various tests substantial deficiencies were found. Remedial action did not result in better operational behaviour. Pressurized filtration of unflocculated raw slimes from Fuerst Leopold colliery resulted in a residual-moisture improvement by only 2 pct. points in comparison to vacuum filtration. The specific solid-mass throughput is of max. 60 kg/m/sup 2/h. When run on flocculated raw slimes, the prototype's filtration result was equal to zero. Further testing would have required comprehensive design changes. Tests with a pilot plant for continuous pressurized filtration 0.5 m/sup 2/ drum filter) have shown that via pressure differentials of approx. 3 bar already residual-moisture improvements by up to 10 pct. points compared to vacuum filtration can be arrived at with an increase of the pressure differential resulting in increased throughput and lower residual moisture. By proportioning of flocculants, the specific mass throughput could be multiplied at pressures above 1 bar. The work on the project was stopped prematurely because, on the one hand, the continuously working pressure filter developed at the same time constituted a technology which had reached operational reliability, and, on the other hand, the comprehensive mechanical engineering changes had not allowed to remain within the time and cost schedule. In the field of slimes filtration for reducing residual moisture work needs to carried on with, in particular in view of processing other slimes which might cause problems. With 7 refs., 3 tabs., 31 figs..

13910 (VTT-TUTK—478) Use and costs of field pellets. Oravainen, H.; Kautto, J.; Linna, V.; Orjala, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). May 1987. 132p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751109/JAW.

Field pellets can be stored in standing silos and this is even cheaper than stockpiling, because no losses will occur. For small-scale consumers field pellets can be stored in big sacks or in smaller paper bags, where pellets will dry during storage to equilibrium moisture content. Field pellets can be dried in pellet form so that they are almost equal to industrial peat pellets. In summer you can use cool air drying and the costs will be small. Drying around the year requires a warm-air drier. The fuel consumption of a warm air drier, which is constructed beside the field pelletization plant, is 1.2 MW, if the pellet production capacity is 4 tons/hour. When the pellets are dried from a moisture content of 30% to 15%, the costs will be FIM 45 per every dried ton of pellets. In small buildings pellets can be successfully burned only by so-called stoker burners. With these burners you can, however, reach only half of the power you could get if you burnt dry pellets, because field pellets must stay longer at the grate than drier pellets, due to the drying process. Ashes of field pellets melt easily and cause problems in those burners and boilers which have no mechanical ash removal. An under feed coal-stoker is with no change suitable for combustion of field pellets in larger buildings. Ash removal from the boiler must be mechanical. The energy price for field pellets at the production site will be FIM 63-80/MWh. When the intermediate storage costs and transport costs at a distance of 40 km are taken into account, the energy price of non-dried pellets will be FIM 76-87/MWh and that of pellets dried to 15% humidity will be FIM 81-92/MWh. The heating costs of a small house, which has been shifted from oil to field pellet heating, are equal to the price of oil heating if the price of light fuel oil is FIM 1.29-1.48/l. In a building with a heating requirement of 200 kW the prices of pellet and oil heating are equal if the oil price is FIM 1.29-1.45/l.

13911 **Coal desulfurization by physical, chemical and microbial beneficiation in the United States.** Deurbrouck, A.W. (USDOE Pittsburgh Energy Technology Center, PA (USA)). pp 1268-1276 of Mining science and technology. Peng Shiji; Wang Dingheng; Wei Renzhi; Lu Shiliang; Hu Mengzhao (eds.). Beijing, China; China Coal Industry Publishing House (1987). (CONF-850997—).

From International symposium on mining technology and science; Xuzhou, China (18 Sep 1985).

Also published by: Trans Tech Publications, Clausthal-Zellerfeld, Federal Republic of Germany.

13912 **FY86 in-house coal preparation research at DOE's Pittsburgh Energy Technology Center.** Killmeyer, R.P. New York, NY; American Institute of Chemical Engineers (1986). 31p. (CONF-860826—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Technical Paper 84A.

Over the last few years, the objective of the DOE Office of Fossil Energy coal preparation program has been, and still is, to develop coal preparation technology that can reduce the ash and sulfur contents of raw coal so that the product can be used directly as a clean fuel that could replace oil and natural gas and reduce environmental emissions. The focus of each project in the coal preparation program is on the potential problems presented by beneficiating ultrafine particles as opposed to conventional size particles. This paper highlights six projects currently being conducted in PETC's Coal Preparation Division: centrifugal float-sink, automated petrography, heavy-liquid cycloning, dry electrostatic separation, froth flotation, and fundamental coal surface science. The objective and background of each project is discussed, along with recent progress and future direction.

0104 Processing

REFER ALSO TO CITATION(S) 13911, 13945, 14020, 14020, 14024, 14028, 14371

13913 **(BMFT-FB-T—86-258) VEW coal conversion process (pressurized operation) - construction and operation of a 10 t/h-prototype plant. Final report.** Deggim, D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Gesellschaft zur Vergasung von Steinkohle m.b.H., Dortmund (Germany, F.R.)). Dec 1986. 66p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751671/JAW.

1. Object: To realize the VEW Coal Conversion Process a prototype plant with a capacity of 10 tons coal per hour under pressurized operation was built. The plant comprises the gasification unit and the complete gas cleaning, which consists of prewashing and H/sub 2/S-removal. The prototype plant is connected with an existing power station, where the cleaned product gas and the residual char from the partial gasification are burnt. 2. Operation programme: The planning and construction of the prototype plant were based on the results gained by previous development steps. More than that further requirements, which arise from the particular problems of the power generating operation were considered while performing the detail engineering. 3. Project status: The plant is completed and is operated within a connective project (project number 03E-1269-B). With 13 figs..

13914 **(BNL—40485) Economical clean carbon and gaseous fuels from coal and other carbonaceous raw materials.** Grohse, E.W.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Nov 1987. Contract AC02-76CH00016. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004075/JAW.

A process is proposed, the HYDROCARB Process, which produces economical clean particulate carbon fuels (liquid and/or solid) and either a hydrogen-rich or a methane-rich gaseous co-product fuel or both. It is basically a two-step process consisting of essentially complete hydropyrolysis of a carbonaceous feedstock such as coal to form primarily methane followed by thermal cracking of this methane-rich gas, after dewatering, to micron-size carbon particulates (carbon black) and hydrogen. The overall carbon conversion and thermal efficiencies obtained, 99+% and 90%, respectively, are exceptionally high. 23 refs., 12 figs., 8 tabs.

13915 **(DOE/MC/10637—2414-Vol.1) Low-rank coal research: Volume 1, Control technology, liquefaction, and gasification: Final report.** Weber, G.F.; Collings, M.E.; Schelkoph, G.L.; Steadman, E.N.; Moretti, C.J.; Henke, K.R.; Rindt, J.R.; Hetland, M.D.; Knudson, C.L.; Willson, W.G. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Apr 1987. Contract FC21-86MC10637. 269p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE87006531/JAW.

Volume I contains articles on SO/sub x//NO/sub x/ control, waste management, low-rank direct liquefaction, hydrogen production from low-rank coals, and advanced wastewater treatment. These articles have been entered individually into EDB and ERA. (LTN)

13916 (DOE/MC/10637—2414-Vol.1, pp 1-58, Paper 3) **Direct liquefaction of low-rank coals: Annual technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March 1987.** Rindt, J.R.; Hetland, M.D.; Knudson, C.L.; Willson, W.G. Apr 1987. NTIS, PC A12/MF A01. Order Number DE87006531/JAW.

In Low-rank coal research: Volume 1, Control technology, liquefaction, and gasification: Final report.

In general, the petroleum residues were not as effective in converting coal to THF solubles during co-processing as were coal-derived solvents. Preliminary study of the solvent balance following co-processing indicates that great differences in utilization by coal exist between the solvents. Staged co-processing studies indicated that when ammonium molybdate was used as a catalyst, im-

provements in conversion to THF solubles would be noted. However, the product distribution which is obtained though the use of this catalyst is not as desirable as that which is obtained when H_2S is used as a promotor. Therefore, the choice of a co-processing catalyst/promotor appears to depend upon whether maximum conversion or optimum product distribution is the run objective. The two methods of silica gel column fractionation developed at UNDERC, when coupled with highfield NMR chromatography, are very useful for providing insight into the organic structure of petroleum resids and crudes. Supercritical fluid chromatography with flame ionization detection (SFC/FID) may be useful in the analysis of non-volatile resids and co-processing products. The aqueous liquefaction runs were physically possible to perform, but in order to attain a more favorable performance, an extraction procedure would be necessary. 12 refs., 27 figs., 16 tabs.

13917 (DOE/MC/10637—2414-Vol.1, pp 1-26, Paper 4)
Production of hydrogen from low-rank coals: Annual technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March 1987. Sears, R.E.; Timpe, R.C.; Musich, M.A.; Cisney, S.J. Apr 1987. NTIS, PC A12/MF A01. Order Number DE87006531/JAW.

In Low-rank coal research: Volume 1, Control technology, liquefaction, and gasification: Final report.

Advanced coal gasification technologies appear to be the most probable alternative for meeting the future demand for large quantities of hydrogen. The greater reactivity of lignites and subbituminous coals, compared to coals of higher rank, make them the probable choice for use in steam gasification. The principal goal of this research project is to establish the feasibility of low-rank coal gasification for low-cost hydrogen production. In parallel with this process development work, an evaluation of the relationship between the fundamental properties of low-rank coals and their reactivity under hydrogen-producing conditions is also being conducted. A CPU utilizing a 6-inch diameter fluid-bed reactor for the determination of the optimum operating conditions for producing low-cost hydrogen was designed and constructed. Parametric testing with the CPU will determine the effects of coal source, catalyst selection, and catalyst concentrations on gas composition and throughput. A plan outlining test procedures and methods of analysis was developed for the fundamental properties and reactivity study of low-rank coals. The methods of analysis included TGA for the reactivity studies; and instrumental analyses such as CP/MAS ^{13}C NMR, XRDA, XRFA, and surface analysis techniques such as ESCA and SEM to fully characterize the coals, chars, and gasification residues. Catalysts chosen, based on previously experimental work, were potassium carbonate and trona. Product gas analyses for selected TGA experiments showed that hydrogen can be produced in concentrations predicted by equilibrium via the catalyzed char-steam reaction. Reactivity of the chars increased by factors of two to four at a given temperature with the addition of catalyst due to increases in surface area and active sites. 11 refs., 16 figs., 6 tabs.

13918 (DOE/MC/10637—2414-Vol.1, pp 1-13, Paper 5)
Advanced wastewater treatment: Final technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March 1987. Apr 1987. NTIS, PC A12/MF A01. Order Number DE87006531/JAW.

In Low-rank coal research: Volume 1, Control technology, liquefaction, and gasification: Final report.

The objective of the fixed-film denitrification studies was to demonstrate the applicability of this process for the treatment of gasification condensate. A program of complete nitrogen removal from wastewater requires the following biochemical processes: carbon oxidation, nitrification and denitrification. These processes are usually performed in separate reactors due to their widely different requirements. Although all of these operations function optimally at neutral pH and at, or slightly above room temperature, they are otherwise very different. In carbon oxidation, organic compounds and dissolved oxygen are required for aerobic oxidation to carbon dioxide, water and biomass. In nitrification, inorganic carbon and dissolved oxygen are required, and large amounts of acid and nitrite or nitrate are produced. In denitrification, organic carbon is required, dissolved oxygen must be absent or in low concentrations, and alkali, carbon dioxide, N_2, and biomass are produced. The microbes involved in carbon oxidation and denitrification have relatively fast growth rates, while the nitrifying bacteria have quite low growth rates. Since the organic load of the wastewater is reduced considerably prior to denitrification and, since organics are required for denitrification, organics must be added. This problem has been addressed by adding a slipstream of raw wastewater to the denitrification reactor, or adding an exogenous organic compound. A number of exogenous organics have been used such as acetate, ethanol and methanol. Of these methanol is believed to be the best choice, and is most often used. 7 refs., 7 figs., 2 tabs.

13919 (DOE/MC/10637—2414-Vol.2, pp 1-21, Paper 4)
Liquefaction reactivity of low-rank coals: Annual technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for period January through March 1987. Apr 1987. NTIS, PC A20/MF A01. Order Number DE87006532/JAW.

In Low-rank coal research: Volume 2, Advanced research and technology development: Final report.

The major goals in the first year have been the development of new methods for the study of the reactivity of low-rank coals and the characterization of oxygen functional groups which are important to the reactivity under low-severity liquefaction conditions. In Task A progress has been made in the methods for determination of carboxylic acid groups and the basis for a new ether determination has been established. Accurate methods for the quantitation of carboxylic acid groups is very important, since the number of these is large and changes considerably during coal processing above 300°C. The determination of ether groups is also very important, since benzyl ethers are believed to be labile linkages between aromatic clusters in the coal structure which are cleaved in liquefaction, and no reliable methods currently exist for ether determinations. The analysis of liquefaction products containing oxygen functional groups will be significantly advanced by the development of combined instrumental techniques which separate components of complex mixtures by gas chromatography and obtain infrared and mass spectra of the eluting components. A serial gas chromatograph, Fourier transform infrared spectrometer, mass spectrometer (GC/FTIR/MS) system has been developed using an ion trap detector or mass analyzer which is interfaced to the light pipe in the FTIR spectrometer. Using this instrumentation, progress has been made in the development of methods for the characterization of oxygen containing compounds which will result from low-severity liquefaction conditions and other reactions.

13920 (DOE/MC/10637—2414-Vol.3, pp 1-22, Paper 5)
Great Plains Gasification Plant improvement feasibility study: Final technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January-March 1987. Wiltsee, G.A. Apr 1987. NTIS, PC A10/MF A01. Order Number DE87006533/JAW.

In Low-rank coal research: Volume 3, Combustion research: Final report.

The objective of this study is to examine and recommend technical options that will utilize excess coal fines from the Great Plains Gasification Plant. These options must be near-term implementable, with process maturity, experience with lignite, and sulfur recovery of at least 90%. Two general process options were selected for consideration: (1) Gasification of fines to produce low Btu gas for burning in the existing Riley boilers to produce process steam. These gasifiers must be air blown since no excess oxygen capacity is available. (2) Atmospheric fluidized bed combustion to provide process steam. Of the 9 processes with sufficient process maturity, three had sufficient air blown experience with lignite to be considered further: Lurgi moving bed, Wellman Galusha, and Lurgi fluid bed. The Lurgi fluid bed was eliminated because it did not have sufficient experience to evaluate its overall efficiency and capital costs. With commercial units of 70 MMBtu/hr, the Wellman Galusha was selected for the (nominal) 100 MMBtu/hr and 250 MMBtu/hr cases. With commercial units of about 600 MMBtu/hr, the Lurgi moving bed was selected for the nominal 500 MMBtu/hr case. Both circulating fluid bed (CFB) and bubbling fluid bed (BFB) combustors qualified for consideration with acceptable sulfur capture 97% carbon utilization, less than 200 ppM NOx emissions,

steam conditions of at least 1200 psi at 900°F, and the capability of utilizing the wide range of moisture, ash, and other constituents in GPGP lignites. CFB was chosen for further development because more experience over the required size range, lower cost per unit of availability, higher overall efficiency, higher sulfur capture, and lower NOx emissions.

13921 **(DOE/MC/21011—2506) Biological upgrading of coal-derived synthesis gas: Final report.** Barik, S.; Johnson, E.R.; Ko, C.W.; Clausen, E.C.; Gaddy, J.L. (Arkansas Univ., Fayetteville (USA)). Oct 1986. Contract AC21-84MC21011. 178p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88001014/JAW.

The technical feasibility of the biological conversion of coal synthesis gas to methane has been demonstrated in the University of Arkansas laboratories. Cultures of microorganisms have been developed which achieve total conversion in the water gas shift and methanation reactions in either mixed or pure cultures. These cultures carry out these conversions at ordinary temperatures and pressures, without sulfur toxicity. Several microorganisms have been identified as having commercial potential for producing methane. These include a mixed culture of unidentified bacteria; P. productus which produces acetate, a methane precursor; and Methanothrix sp., which produces methane from acetate. These cultures have been used in mixed reactors and immobilized cell reactors to achieve total CO and H_2 conversion in a retention time of less than two hours, quite good for a biological reactor. Preliminary economic projections indicate that a biological methanation plant with a size of 5 x 10^{10} Btu/day can be economically attractive. 42 refs., 26 figs., 86 tabs.

13922 **(DOE/PC/60800—14) Active sites in char gasification: Final technical report.** Wojtowicz, M.; Lilly, W.D.; Perkins, M.T.; Hradil, G.; Calo, J.M.; Suuberg, E.M. (Brown Univ., Providence, RI (USA). Div. of Engineering). Sep 1987. Contract FG22-83PC60800. 251p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88000893/JAW.

Among the key variables in the design of gasifiers and combustors is the reactivity of the chars which must be gasified or combusted. Significant loss of unburned char is unacceptable in virtually any process; the provision of sufficient residence time for complete conversion is essential. A very wide range of reactivities are observed, depending upon the nature of the char in a process. The current work focuses on furthering the understanding of gasification reactivities of chars. It has been well established that the reactivity of char to gasification generally depends upon three principal factors: (1) the concentration of "active sites" in the char; (2) mass transfer within the char; and (3) the type and concentration of catalytic impurities in the char. The present study primarily addresses the first factor. The subject of this research is the origin, nature, and fate of active sites in chars derived from parent hydrocarbons with coal-like structure. The nature and number of the active sites and their reactivity towards oxygen are examined in "model" chars derived from phenol-formaldehyde type resins. How the active sites are lost by the process of thermal annealing during heat treatment of chars are studied, and actual rate for the annealing process is derived. Since intrinsic char reactivities are of primary interest in the present study, a fair amount of attention was given to the model char synthesis and handling so that the effect of catalytic impurities and oxygen-containing functional groups in the chemical structure of the material were minimized, if not completely eliminated. The project would not be considered complete without comparing characteristic features of synthetic chars with kinetic behavior exhibited by natural chars, including coal chars.

13923 **(DOE/PC/70802—T7) Coal liquefaction study under the nonisothermal reaction temperature: Final report.** Kwon, K.C. (Tuskegee Univ., AL (USA). Dept. of Chemical Engineering). May 1987. Contract FG22-84PC70802. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014402/JAW.

Kentucky No. 9 coal was soaked with 1-methylnaphthalene 60 minutes at 250°C and 300°C and liquefied with molecular hydrogen for 15 minutes at 380°C to investigate effects of soaking temperatures on liquefaction in the presence of various hydrogen donor solvents. Coal liquefaction runs were conducted for both Kentucky No. 9 coal and Wyodak coal, increasing coal liquefaction temperatures from 200°C or 300°C up to 380°C for 15 minutes to identify roles of hydrogen donor solvents in the early stages of coal liquefaction. Effects of reaction severity on liquefaction of coal in the presence of water were investigated. A series of coal liquefaction runs were conducted for Kentucky No. 9 coal, increasing coal liquefaction temperatures from 200°C or 300°C up to 380°C. Objectives are (1) to investigate effects of reaction severity on coal liquefaction, (2) to understand roles of hydrogen donor solvents in the early stage of coal liquefaction, (3) to study effects of initial liquefaction temperatures on coal liquefaction, and (4) to evaluate effects of hydrogen donor solvents on product distributions in the early stages of liquefying Kentucky No. 9 coal at nonisothermal liquefaction temperatures. 16 figs., 5 tabs.

13924 **(DOE/PC/71257—T13) Novel experimental studies for coal liquefaction: Quarterly progress report, July 1, 1987-September 30, 1987.** Holder, G.D.; Tierney, J.W. (Pittsburgh Univ., PA (USA)). 1987. Contract FG22-84PC71257. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002432/JAW.

Research is being carried out in this project in two areas which are of interest to ongoing investigations at the Pittsburgh Energy Technology Center (PETC). They are: (a) thermal behavior of slurry reactors used for indirect coal liquefaction; and (b) coal liquefaction under supercritical conditions. The current status of each of these tasks is summarized in this report. 76 refs., 23 figs., 6 tabs.

13925 **(DOE/PC/79806—T1) Characterization and suitability of superclean coals for hydroliquefaction feedstocks: Technical progress report for the period of October 1, 1987 to December 31, 1987.** Kim, N.K. (Michigan Technological Univ., Houghton (USA). Dept. of Chemistry and Chemical Engineering). 15 Jan 1988. Contract FG22-87PC79806. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004677/JAW.

The objective of the research was to evaluate the effect of superclean coals as produced from various domestic coals usign MTU's flotation technology on direct coal liquefaction. The micronized and successively clean coals range from 1.0% to 20% in ash content and contain various sulfur concentrations. They are to be assessed as coal conversion feedstocks. Thus, the proposed project will evaluate the effects of ash, sulfur, and the ultrafineness of coal feed on the hydroliquefaction process. 4 figs., 3 tabs.

13926 **(DOE/PC/80752—T10) Detailed model for practical pulverized coal furnaces and gasifiers: Quarterly technical progress report No. 8 for the period 1 August 1987 to 31 October 1987, tenth quarterly reporting period.** Smith, P.J.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 30 Nov 1987. Contract FG22-85PC80752. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003847/JAW.

The general objective of this study is to improve and extend a generalized two-dimensional, pulverized coal combustion and gasification code for application to large-scale, practical configurations, and to evaluate and implement the resulting code on an industrial scale. This report summarizes work conducted during the second quarter of the third year (tenth quarter) of this contract. A summary of work accomplished during this quarter is given by task and includes only tasks where significant progress was made during this quarter. These tasks are: 3-D Model Development; Model Evaluation; Subcomponent Models; Fouling and Slagging; and Technology Transfer. 31 refs., 12 figs., 2 tabs.

13927 **(DOE/PC/90017—T14) Cooperative research in coal liquefaction infratechnology and generic technology development: Quarterly report, July 1-October 1, 1987.** Huffman, G.P.; Sendlein, L.V.A. (Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA)). 1987. Contract FC22-86PC90017. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002382/JAW.

Research programs in coal liquefaction continued in the following areas: (1) catalytic coal liquefaction using Mo catalysts; (2) coprocessing experiments, using Maya topper long resid as a solvent for Illinois No. 6 coal using a variety of both unimodal and bimodal catalysts. The effect of agitation rate on conversion in a horizontally aligned tubing bond experiment was investigated; (3) the effect of tetrabutyltin and $FeSO_4 \cdot 7H_2O$ catalysts on coprocessing. A mathematical model was used to determine critical coprocessing rate constants; (4) a study of the bond cleavage reactions of benzl phenyl ethers was completed. Similar bond cleavages may be induced in coal and lead to liquid products under low severity conditions. EPR studies of Cr(V) model compounds established an unusual lineshape. Solvent extraction using N-methyl-2-pyrrolidone on a high resinite coal from Utah. New NMP experimets are in progress on oil shales and tar sands. New experimental apparatus has been devised for investigating the kinetics of the extraction process; (5) collection and analysis of the eastern Kentucky coals was completed. Chemical and petrographic analyses were placed in the KECL coal data base; (6) liquefaction screening of the eastern Kentucky coals was completed. Liquefaction data is being correlated with the coal properties; (7) a new ^{13}C NMR technique, variable angle sample spinning (VASS), show great promise for determining the average cluster size in coal. Sink/float methods are being developed to obtain gram quantities of maceral enriched (> 90%) specimens on which liquefaction studies can be made. Pyrolysis and mass spectrometry studies are being made on raw Elkhorn coal; (8) biological desulfurization studies emphasized experiments with Sulfolobus brierleyi. The growth of Sulfolobus solfataricus on casamino acids and yeast extract was investigated; (9) the CFFLS computer network/liquefaction database became operational. 4 refs., 13 figs., 18 tabs.

13928 **(EPRI-AP—5448) Production costing: Combined-cycle and gasification-combined-cycle plants: Software logic guide: Final report.** Betley, F.M.; Ferrier, C.E.; Powers, G.R.; Scherer, S.M. (Potomac Electric Power Co., Washington, DC (USA)). Dec 1987. 148p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920121/JAW.

This manual describes the development, structure and capabilities of an enhanced utility system production costing software as well as the results of a testing and validation effort. The software provides a tool for estimating the potential production cost impact of combined-cycle as well as alternative phased GCC construction options including estimates of unit availability, overall plant capacity, heat rate and fuel mix. The software logic has been incorporated into a widely used production costing computer program (PROMOD III) that is employed by many utilities to analyze system generation expansion plans. The software is designed to capture the unique characteristics of the GCC technology and maintain the same relative level of detail as used to describe conventional generation plants in the computer program. Five unique features of GCC plants which distinguish them from conventional generation form the framework of the software. First, the ability to recognize backup fuel-firing capability is incorporated. Second, the software specifically recognizes the modularity of the GCC technology and performs dispatch based on the recognition that when the plant fails, it is in various modes of partial outage rather than a full forced outage state. Third, the software identifies plant capacity and heat rate differences by distinguishing between the two power sources within the GCC and the availability of the gasification equipment. Fourth, the development of a separate dispatch segment reflects the supplemental firing feature which allows the introduction of fuel directly into the heat recovery steam generator. Finally, the system is designed to distinguish between GCC design configurations. Computer calculations of capacities, heat rates and availabilities are reported in a form which facilitates use of the software for exploring data consistency and probabilistic calculations. 13 figs., 45 tabs.

13929 **(EPRI-AP—5505) Process screening study of alternative gas treating and sulfur removal systems for IGCC [Integrated Gasification Combined Cycle] power plant applications: Final report.** Biasca, F.E.; Korens, N.; Schulman, B.L.; Simbeck, D.R. (SFA Pacific, Inc., Mountain View, CA (USA)). Dec 1987. 64p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920130/JAW.

One of the inherent advantages of the Integrated Gasification Combined Cycle plant (IGCC) over other coal-based electric generation technologies is that the sulfur in the coal is converted into a form which can be removed and recovered. Extremely low sulfur oxide emissions can result. Gas treating and sulfur recovery processes for the control of sulfur emissions are an integral part of the overall IGCC plant design. There is a wide range of commercially proven technologies which are highly efficient for sulfur control. In addition, there are many developing technologies and new concepts for applying established technologies which offer potential improvements in both technical and economic performance. SFA Pacific, Inc. has completed a screening study to compare several alternative methods of removing sulfur from the gas streams generated by the Texaco coal gasification process for use in an IGCC plant. The study considered cleaning the gas made from high and low sulfur coals to produce a low sulfur fuel gas and a severely desulfurized synthesis gas (suitable for methanol synthesis), while maintaining a range of low levels of total sulfur emissions. The general approach was to compare the technical performance of the various processes in meeting the desulfurization specifications laid out in EPRI's design basis for the study. The processing scheme being tested at the Cool Water IGCC facility incorporates the Selexol acid gas removal process which is used in combination with a Claus sulfur plant and a SCOT tailgas treating unit. The study has identified several commercial systems, as well as some unusual applications, which can provide efficient removal of sulfur from the fuel gas and also produce extremely low sulfur emissions - so as to meet very stringent sulfur emissions standards. 29 refs., 8 figs., 8 tabs.

13930 **(ORNL/Sub—85-27429/01) Study of damage mechanisms in coal conversion atmospheres affecting the fatigue and creep rupture properties of Cr-Mo steels: Final technical report, March 15, 1985-March 14, 1987.** Spencer, P.N.; Dauskardt, R.H.; Ritchie, R.O.; Parker, E.R. (California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering). Apr 1987. Contract AC05-84OR21400. 133p. (UCB/RP—87/D1046). NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88005003/JAW.

This report presents results of a two year research program to study damage mechanisms associated with high-temperature, high-pressure, hydrogen service (i.e., coal conversion applications) and affecting metallurgical stability and mechanical properties, in particular, fatigue crack propagation and creep rupture properties, of weld metal and heat affected zone (HAZ) regions in thick section weldments in two Cr-Mo steels, namely 3Cr-1-1/2Mo-1/2Ni steel, hereafter referred to as Berkeley steel, and 3Cr-1Mo-1/4V-Ti-B, referred to as JSW (Japan Steel Works) steel. In addition, suggestions on how microstructures might be modified to avoid such damage are discussed. As base metal tests on specimens from laboratory-sized heats had shown good resistance to environmentally-induced damage, the objective of the work was to discern whether such properties could be maintained in thick-section weldments in materials taken from relatively large (commercial size) heats. Both materials, in the PWHT/undamaged state, exhibited identical fatigue crack growth behavior above $\sim 10^{-6}$ mm/cycle. At near-threshold levels, the JSW steel displayed marginally lower growth rates and a higher threshold stress intensity, ΔK/sub TH/. When PWHT materials were exposed to environmentally-induced damage (i.e., high temperature/high pressure hydrogen), little effect was observed on fatigue propagation behavior at both near-threshold and higher growth rates. 72 refs., 41 figs., 13 tabs.

13931 (VTT-TIED—689) Gas cleaning at high temperatures and pressures for gas turbines. Kurkela, E.; Mojtahedi, W. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Mar 1987. 114p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751171/JAW.

In industrial gas turbine power plants based on pressurized fluid-bed combustion or gasification of solid fuels, gas cleaning at a high temperature and pressure forms the greatest problem. Problems caused by particles and alkali metals and their removal from hot flue gases and from product gases of gasification are discussed in the literature review. The particle content of the gas to be led into the gas turbine must be reduced to prevent erosion. There are different estimates of the purity level required. According to some sources the maximum particle content is 100-200 ppm. The content of >10 μm particles should not exceed 1 ppm and that of >5 μm particles 10 ppm. There are also different opinions about alkali metals and corrosion problems. Gas cleaning methods in gasification and fluid-bed combustion differ from each other in many respects. In the gas turbine processes based on gasification the gas can also be purified conventionally at a low temperature. The volume flow of the gas to be cleaned is only 15-35% of that in fluid-bed combustion. The carbon content of the paraticles from gasification is usually 30-70% w/w, whilst in fluid-bed combustion the content of unburnt carbon is less than 5% w/w. In the hot cleaning of gasification gas problems are caused especially by tarry impurities and, at certain temperatures, by carbon-forming reactions. As regards cleaning equipment in a hot space, there are industrial-scale experiences only from the use of cyclones in conditions corresponding to gas turbine use. However, the separation capacity of the conventional cyclones is too low for small particles. The use of new multicyclone in a pressurized space still involves many unsolved problems. Of the other purification methods, ceramic filters are considered most promising. Encouraging results have also been obtained from the use of electric precipitators at <800 deg C temperatures.

13932 Modified alloy-800 offers improved corrosion resistance in coal gasification environments. *Materials and Components in Fossil Energy Applications;* No. 66, 5-6(1 Feb 1987).

In coal gasification plants based upon nuclear process heat, the energy required for the gasification process is produced in a nuclear reactor and is supplied via a heat exchanger. The materials in this heat exchanger are subjected to high temperature corrosion in a gas atmosphere containing CO, CO_2, CH_4, and various levels of H_2S, depending upon the coal being gasified. The commercial alloy initially suggested for this service was alloy 800. However, preliminary laboratory tests indicated that this material would not be satisfactory and that no suitable commercial alloy was available. Consequently, a program was begun to optimize the chemical composition with the goal of achieving adequate high temperature creep strength as well as good high-temperature corrosion resistance. Results are discussed for both low-sulfur and high-sulfur coal tests. 2 tables.

13933 IGCC plant to use hot gas cleanup. *Materials and Components in Fossil Energy Applications;* No. 66, 7-8(1 Feb 1987).

Plans are proceeding for a 60 MW(e) integrated gasification combined cycle (IGCC) demonstration plant which features an air-blown, pressurized fluidized-bed gasifier, a fluidized bed of limestone to act as a sulfur getter, and a hot gas cleanup system. The new plant will use 485 tons per day of crushed and sized coal and 111 tons per day of limestone. The fuel gas leaves the gasifier at about 980°C and passes through a radiant cooler, in which the hot, dirty gas flows parallel to steam generator tubes in an effort to minimize erosion and fouling problems and is cooled to about 550 to 650°C. The gas then passes through a hot particle removal system and then into an external desulfurization bed before being fed into a gas turbine at about 537°C. The hot gas cleanup train consists of cyclones in series, followed by a sintered metal filter. The external desulfurization system is based on a mixture of zinc oxide and iron oxide. The sulfated zinc ferrite from this desulfurizer is regenerated by heating to produce a mixture of hydrogen sulfide and steam, which will be fed back into the gasifier so that the sulfur can be captured in the limestone bed. Current plans are for construction to start on a site at Cairnbrook, Pennsylvania late in 1987, with startup two years later.

13934 Hydrogen utilization in direct conversion. Finseth, D.; Bockrath, B.C.; Illig, E.G.; Lett, R.G.; Retcofsky, H.L. (USDOE Pittsburgh Energy Technology Center, PA). pp 173-175 of 1987 international conference on coal science. Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers (1987). (CONF-871030—).

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

Discusses hydrogen utilization as a function of reaction time in direct coal liquefaction. From the data it is suggested that the reaction of hydrogen with the coal slurry goes through two phases: a phase at short reaction times characterized by a net reduction in system hydrogen (dehydrogenation or condensation), and a second phase at longer reaction times characterized by incorporation of hydrogen via slow bond-cleavage chemistry. 3 refs.

13935 Kinetics and theoretical treatment of primary radical displacement at sulfur. Franz, J.A.; Ferris, K.F.; Roberts, D.H.; Bartlett, R.J.; Magers, D. (Pacific Northwest Laboratory, Richland, Washington (USA)). pp 183-186 of 1987 international conference on coal science. Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers (1987). (CONF-871030—).

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

Pathways of formation of carbon-sulfur bonds are of particular importance to coal liquefaction. Intramolecular radical displacement reactions at sulfur may contribute to the formation of the thiophene ring structure and aryl-substituted homologues in competition with pathways involving intramolecular addition of arylthio radicals to nearby aromatic systems. This paper presents results of a kinetic study of intramolecular radical displacement at sulfur and discusses results of an ab initio many-body perturbation theory (MBPT) study of the trimethyl sulfuranyl radical, a model for possible intermediate trialkylsulfuranyl radicals in the displacement reactions. Arrhenius expressions for intramolecular displacement of a variety of alkyl groups are discussed in terms of intermediate trialkylsulfuranyl radicals versus simple tricoordinate transition structures. The level of theoretical treatment to obtain accuracy comparable to experiment is evaluated, and theoretical predictions of the energetics and the extent of stereochemical control in radical displacement reactions at sulfur are discussed. 5 refs.

13936 Sulfur in coal: model studies of the role of ArS radicals in C-C and C-S bond formation and structural evolution in coal liquefaction. Alnajjar, M.S.; Franz, J.A. (Battelle, Pacific Northwest Laboratories, Richland, WA (USA)). pp 273-276 of 1987 international conference on coal science. Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers (1987). (CONF-871030—).

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

The course of thermal liquefaction of coal depends on the presence of heteroatoms, particularly sulphur. Phenyldisulfide was used to examine the reaction of the thiophenoxy radical produced at high temperatures with a variety of coal model compounds. Results demonstrated that the participation of the PhS radical enhanced the cleavage of carbon-carbon bonds via a series of radical abstraction, cyclization, addition and displacement reactions. 17 refs.

13937 Structural features of Big Brown lignite and liquefaction products. Olson, E.S.; Diehl, J.W.; Froehlich, M.L.; Heintz, M.; Knudson, C.L.; Worman, J.J.; Sharma, R. (University of North Dakota Energy Research Center, Grand Forks, ND (USA)). pp 311-314 of 1987 international conference on coal science. Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers (1987). (CONF-871030—).

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

The structure and reactivity of Texas lignite from the Big Brown Mine have been studied in order to understand the nature of C-O bond cleavage reactions and the role of hydroaromatic groups during two-stage liquefaction processing. Low severity liquefaction with CO and H_2S followed by a catalytic hydrotreatment has been investigated. 5 refs.

13938 Coal liquefaction and upgrading benefit from heteroatom removal. Moroni, E.C. (Department of Energy, Washington, DC (USA)). pp 351-354 of 1987 international conference on coal science. Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers (1987). (CONF-871030—).

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

Presents results of studies carried out to explain the role of heteroatoms in catalytic coal liquefaction. The effect of removing heteroatom-containing compounds from the solvent in both catalytic and non-catalytic reactions is discussed. It was shown that removal of heteroatoms is beneficial throughout coal liquefaction. 10 refs.

13939 Base catalyzed desulfurization and heteroatom elimination from coal-model heteroaromatic compounds. Friedman, S.; Utz, B.R.; Nowak, M.A.; Fauth, D.J.; Schmidt, C.E. (USDOE Pittsburgh Energy Technology Center, PA). pp 435-438 of 1987 international conference on coal science. Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers (1987). (CONF-871030—).

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

Describes the removal of pyritic sulfur from coal by molten caustic and its reaction mechanism. Dibenzothiophene, benzothiophene, and thiophenol as models for the organosulphur in coal, were desulfurized by molten caustic at 375-400 C. It was found that ring opening of the heterocyclic rings is base catalysed, and base activity is cation dependent. Desulfurization of the resultant thiolate ion is catalyzed by metals or by metal ions mobilised by caustic. Also, molten caustic activates inactive metals. 5 refs.

13940 Results from Grimethorpe PFBC turbine cascade tests. *Materials and Components in Fossil Energy Applications;* No. 65, 1-4(1 Dec 1986).

The test program at the Grimethorpe Pressurized Fluidized-Bed Combustion (PFBC) facility included an assessment of the potential for deposition, corrosion, and erosion of gas turbine blade materials when exposed to PFBC off gases. Flue gas from the combustor was fed through three stages of cyclones before entering the cascade. The impulse foils were approximately the size and shape of the first stage blades in the GE MS-1002 gas turbine. The cascade operated through three test series, accumulating a total of 649 hours. The conditions experienced are summarized. The paper lists the alloys tested, and discusses the efficiency of the cyclones, the particle size distribution of the dusts not removed by the cyclones, and corrosion of the turbine blades. 4 references, 1 figure, 2 tables.

13941 Ceramic filter element survives 2000-cycle PFBC test. *Materials and Components in Fossil Energy Applications;* No. 61, 5-6(1 Apr 1986).

One of the devices under investigation for removal of particulate matter from high-temperature high-pressure gases is the Schumachel rigid ceramic filter. This is made in elements which are 1.5 m long, 6 cm diameter tubes fabricated by a proprietary process based on silicon carbide containing tufts of alumina. Tests were carried out in a Westinghouse test rig, in which natural gas was burned to create a steady-state, high-temperature, high pressure gas stream laden with ash from the Exxon pressurized fluidized-bed miniplant combustor. Overall, the test emphasized the promise of this type of filter elements, and pointed out two areas of concern: mechanical stresses on the filter seals and internal filter support members resulting from the pressure drop across the element, and stresses resulting from rapid temperature cycles. A further test of at least 1000 hr. duration is planned, using six elements in a side stream from a coal-fired pressurized fluidized bed combustor.

13942 Application of the KRW coal gasification hot gas cleanup technology to combined cycle electric power generation. Lewandowski, D.A.; Weldon, J.; Haldipur, G.B. New York, NY; American Institute of Chemical Engineers (1986). 24p. (CONF-860826—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Technical Paper 62D.

KRW Energy Systems Inc. developed a process for in-situ desulfurization of the gas produced in a fluidized bed coal gasifier. The feasibility of the process is demonstrated by the 500 plus hours of pilot plant operation accomplished with both dolomite and limestone sorbent injection and by the greater than 90 percent sulfur removal achieved. A full-flow sintered metal filter is used for removal of particulates from the product gas at temperatures up to 1200°F. The gas exiting this filter was found to meet New Source Performance Standards (NSPS) for NO/sub x/ emissions and gas turbine tolerance limits for alkali and trace metals without any further treatment; therefore, it can be used directly in a gas turbine, improving the process efficiency for combined cycle electric power generation application.

0105 By-products

REFER ALSO TO CITATION(S) 14027

13943 (EUR—10746-FR) Improvement of blast furnace charging by studying material flow in the stack and measuring the form of the meltdown zone. Nicolle, R.; Steiler, J.M.; Metz, B.; Bailly, J.L.; Wanin, M.; Libralesso, J.M.; Henry, P.; Biausser, H. (Commission of the European Communities, Luxembourg). 1987. 267p. (In French). Commission of the European Communities, Luxembourg.

Research into the influence of blast furnace charging and into the nature of the charge on the shape of the cohesive zone, as well as on the burden structure in the vicinity of the furnace walls has been carried out. The research has used various methods of investigation including direct measurements in a working blast furnace and an industrial scale model to investigate the burden structure near the walls. A new method of measuring the isotherms using steel capsules containing radioactive xenon has been developed. This technique has provided a great deal of information on the internal state of the blast furnace. Variations in the shape of isotherms and in gas distribution have been observed and interpreted using a mathematical model (CLEF). The most striking result was determination of the relationship between burden charging (ore/coke ratio at the furnace walls) and gas flow near the walls. Research has also been carried out on a model to investigate the dynamics of burden flow near the furnace walls. Information on ore/coke mixed layers near rough furnace walls has been characterized. The research has increased understanding of the internal state of the blast furnace.

0106 Properties

REFER ALSO TO CITATION(S) 13925, 13966, 13967, 13968, 13982, 13983, 13984, 13985, 13986, 13987, 13988, 13989, 13990, 13991, 13992, 13993, 13994, 13995, 13996, 13997, 13998, 13999, 14000, 14001, 14002, 14003, 14004, 14005, 14017, 15362

13944 (CONF-870410—40) High-density jet fuels from coal syncrudes: Appendix 4. Sullivan, R.F. (Chevron Research Co., Richmond, CA (USA)). 1987. Contract AC22-76ET10532. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003132/JAW.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Very dense jet-boiling-range hydrocarbons can be obtained by hydrotreating and hydrocracking syncrudes made from coal in direct liquefaction processes. Heteroatom impurities must be removed, and most of the aromatics must be hydrogenated at high severity in order to produce kerosene jet fuels from coal syncrudes that meet smoke point and stability specifications. The resulting hydrotreated products consist mainly of naphthenes containing from

one to three rings. If hydrocracking is added as a conversion step, some four-ring naphthenes are found in the 250 to 550°F jet fuel products. Polycyclic naphthenes are desirable components for jet fuel because of their high volumetric energy contents and low freezing points. Products from the ITSL liquefaction process from bituminous coal had the lowest paraffin contents and the highest densities (for a given boiling range and aromatic content) of any of the coal liquids studied. Actual engine tests, however, would be needed to demonstrate that these fuels qualify for service in jet aircraft. 11 refs., 6 tabs.

13945 **(CONF-870796—3) Low temperature reactivity of chars towards oxygen: Appendix E2.** Wojtowicz, M.; Calo, J.; Lilly, W.; Suuberg, E. (Brown Univ., Providence, RI (USA)). 1987. Contract FG22-83PC60800. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004088/JAW.

From 18. biennial carbon conference; Worcester, MA, USA (19 Jul 1987).

For only the very low burnoff chars is there observed unusually low reactivity, even when corrected for surface area. Thus, the similarities of the different materials are again noted, when compared at the same burnoff. From these and other data, we are developing a picture of low temperature char gasification that involves the following steps: (1) sorption of oxygen onto "active sites"; (2) reaction of oxygen with surface oxides to release oxides of carbon; and (3) thermal decomposition of surface oxides to release oxides of carbon. Separately, we are developing a model of char annealing during heat treatment. The degree to which process 3 competes with process 2 seems to be a function of the nature of the char. Proper accounting for reactions of type 3 is important in sorting out reaction order, especially at low oxygen partial pressures. We have observed an overall apparent order of reaction of O_2 with char in the temperature range 573 to 673°K of roughly 0.7 to 0.8. This is, again, not a function of extent of heat treatment of the char, although the overall reactivity varies by more than an order of magnitude from the low temperature to the high temperature chars. The apparent activation energies for the annealing process are presented. 8 refs., 3 tabs.

13946 **(CONF-870802—32) Characterization of the benzene methanol extracts from the Argonne Premium Coal Samples.** Xia, Y.J.; Neill, P.H.; Winans, R.E. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003018/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

Significant differences have been observed in the total amount of material extracted from Argonne Premium coal samples and the swelling coefficients of the resulting residues. Each generally decreased with increasing carbon content. Differences were observed in the amount of the extract proportionating into each of the LC fraction. A higher percentage of the extract from coals of lower rank appeared to elute in the more polar fractions, although the experimental procedure will have to be refined before one can be sure that this conclusion is valid. There did not appear to be any significant differences between the intrafraction maximum in the molecular weight profile for any of the samples. The data reported in this paper represents baseline values for the benzene/methanol extractables from the Argonne Premium Coals. 10 refs., 7 figs., 2 tabs.

13947 **(CONF-870802—33) Multinuclear NMR [nuclear magnetic resonance] characterization of the layer silicates in Argonne Premium Coals and model systems.** Thompson, A.R.; Botto, R.E. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003015/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

NMR has been applied to the entire suite of Argonne Premium Coals before and after separation of the detrital mineral particles by sink-float separation. Preliminary results are presented for the direct characterization of the minerals more intimately associated with the organic portion of these coals. Spectra of the density separated fractions demonstrate that different mix of minerals is dispersed in the organic matrix compared to that found for the detrital materials. 5 refs., 2 figs., 1 tab.

13948 **(CONF-870802—35) The application of inverse gas chromatography to coals and oxidized coals.** Neill, P.H.; Winans, R.E. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003011/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

Preliminary results have been previously reported concerning the application of Inverse Gas Chromatography (IGC) to coals and air oxidized coals. We will report on the reproducibility of the IGC technique, its application to other Argonne Premium Coals, and compare the results with those obtained with pyrolysis mass spectroscopy. The objective is to provide detailed information concerning the possible nonoxidative changes in the chemical and physical structures of the Argonne Premium Coal Samples (APCS) during long term storage. Inverse gas chromatography is just one of the techniques being utilized in meeting this objective. It is known that subtle changes in coal structure can effect changes in plasticity when a coal is heated. However, the techniques traditionally used to measure plasticity do not yield information which can be used to understand the underlying chemical and physical changes in the coal structure. 8 refs., 7 figs., 2 tabs.

13949 **(CRIEPI-W—86019) Development of automatic measurement equipment of dust resistivity and measurement results of various dust.** Nagayama, T. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1987. vp. (In Japanese). Central Research Institute of Electric Power Industry, Tokyo, Japan.

Automatic measurement equipment for dust resistivity has been developed and the resistivity of char, charcoal ash and oil ash has been measured. The results are as follows: the accuracy of dust resistivity became very good due to the automatic revision of unknown current and the individual difference becoming smaller by automatic operation; the accuracy of coal ash resistivity was under 1%, oil ash resistivity was in the range of approximately 4 to 7%, and char resistivity was in the range of approximately 11 to 22%; the difference of char resistivity among different kinds of coal was very small and is almost of the order of 10^4; among the same kind of coal, coal ash resistivity changed due to different coal firing systems and types of denitrating equipment.

13950 (DOE/MC/10637—2414-Vol.2, pp 1-53, Paper 5) **Ash and slag characterization: Final technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March 1987.** Falcone, S.K. Apr 1987. NTIS, PC A20/MF A01. Order Number DE87006532/JAW.

In Low-rank coal research: Volume 2, Advanced research and technology development: Final report.

The formation, physical properties and behavior of ash in coal gasification systems can have a major impact on the design and subsequent operation of the systems. Indeed, the behavior of the ash has to be considered in order to decide whether a given coal is suitable for utilization in a given system. The overall objective of the program is to obtain laboratory and bench-scale data on the formation, flow, and sticking behavior of coal ash and slag under gasification conditions. The eventual outcome will be a unified picture of the behavior of inorganic species within the gasifier. The unified picture will be invaluable to the designers and gasifier operators in assessing a coal for utilization in gasification systems. Specific goals were set: the determination of mineralogical and composition changes of ashes and synthetic mixtures under reducing conditions; study of the volatilization of organically associated inorganics; the determination of the viscosity of ash melts; and synthetic mineral mixtures on various refractory substrates. An associated goal was the establishment of an extensive data base of the data obtained from this study and other sources. An important aspect of this project is to relate the results and understanding obtained to that observed in pilot-scale and full-scale gasification systems. The Lurgi gasifiers at the Great Plains Gasification Project have a recurring problem with excessive clinkering of ash. A sample of non-agglomerated ash and clinker was collected and ana-

lyzed at UNDERC. The chemical composition and crystalline phases present in the two samples were quite different. The observations could be directly attributed to the higher calcium oxide content of the clinker. 41 refs., 23 figs., 10 tabs.

13951 (DOE/PC/70798—T11) Weathering effects on the structure and reactivity of US coals: Final report, July 15, 1984-July 14, 1987. Meuzelaar, H.L.C.; Hill, G.R.; Yun, Yongseung; Jakab, E.; Windig, W.; Urban, D.; Yon, Kyung Yol; Oestreich, J.; East, J. (Utah Univ., Salt Lake City (USA). Biomaterials Profiling Center). 1987. Contract FG22-84PC70798. 158p. NTIS, PC A08/MF A01; GPO Dep. Order Number DE88002107/JAW.

This report covers the work performed from July 1984 to July 1987 under the project entitled "Weathering Effects on Structure and Reactivity of US Coals" (grant number FG22-84PC70798). The main objectives of the study were to investigate the structural changes in coal during the weathering process as well as to develop a simple, reliable weathering index, which can monitor indirectly the weathering-induced changes in physical and chemical properties. Although there have been numerous publications on structure and reactivity of coal, most data reported in the literature thus far have been obtained on coal samples of uncertain weathering status and therefore need to be interpreted with great caution. Weathering has a profound effect on many important coal properties such as heating value, caking characteristics, acidity, flotability and reactivity in liquefaction, combustion and gasification processes. The objective of developing a weathering index is to predict these coal property changes due to weathering without resorting to real-time measurements or pilot plant runs. This report is comprised of four main chapters: I. Structural Changes due to Weathering; II. Material Balance in Weathering Process; III. Development of a Reliable Weathering Index; and IV. Proposed Weathering Mechanisms. A battery of sophisticated analytical tools and techniques was employed during this study. Pyrolysis mass spectrometry in time-integrated, as well as in time-resolved modes with computer-aided data analysis techniques (such as factor and discriminant analysis), gas chromatography, thermogravimetry/mass spectrometry and solvent extraction were used for determining the role of oxygen during the weathering process. Pyrolysis mass spectrometry, Free Swelling Index and a novel slurry pH technique were employed as weathering indicators. 170 refs.

13952 (DOE/PC/70799—T11) Identification of nonvolatile coal derived products via chromatography coupled with on-line FTIR DETECTION: Quarterly progress report, March 1, 1987-May 31, 1987. Taylor, L.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Nov 1987. Contract FG22-84PC70799. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002731/JAW.

Nitrogen-containing compounds with basicities ranging from pK/sub a/ = -3 to pK/sub a/ = +7 have been separated via supercritical fluid chromatography employing packed columns. The presence of methanol as a modifier to the supercritical CO_2 promoted elution and improved peak shapes. While the modifier effect with the PRP-1 column is not explainable, it would appear that for silica based columns (silica, C_{18} and NH_2) the methanol deactivates silanol sites via hydrogen bonding. The propylamino phase yielded the best results. Partitioning of the analytes with the octadecyl phase seemed to be minimal. Interaction with accessible silanol sites appeared to dominate the separation mechanism in the absence of modifier. In the presence of modifier, partitioning with the propylamino phase is suggested. 21 refs., 7 figs., 5 tabs.

13953 (DOE/PC/80503—T9) Transport and relaxation processes in supercritical fluids: Technical progress report, September 16, 1987 to December 15, 1987. Jonas, J. (Illinois Univ., Urbana (USA)). 1987. Contract FG22-85PC80503. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004804/JAW.

Our efforts were concentrated on measurements of relaxation times for the system naphthalene-supercritical ethylene and on theoretical analysis of extensive diffusion data on liquid 2-ethylhexylbenzoate. Recent work has dealt primarily with the reorientation of naphthalene in supercritical carbon dioxide. Though these and earlier investigations of this system have provided an understanding of transport and relaxation processes in supercritical fluid mixtures, it was decided that studying the reorientation of d_8-naphthalene in supercritical ethylene would complement our understanding of this type of system. As before, we measured the deuterium spin-lattice relaxation time, T_1, of the solid solute dissolved in the supercritical fluid. We also investigated a state consisting of liquid d_8-naphthalene and supercritical ethylene. Spin-lattice relaxation times of d_8-naphthalene were measured at two different temperatures as a function of ethylene pressure. The conditions a these temperatures of 45° and 30°C correspond to a region of the ethylene-naphthalene phase diagram where solid naphthalene is dissolved in supercritical ethylene. Though there is a great amount of data concerning this region due to the applicability of supercritical extraction processes, this is the only T_1 data, to our knowledge, which exists concerning this system. We intend to measure T_1's along another isotherm at 15°C.

13954 (DOE/PC/80910—T1) A study of depolymerization and crosslinking reactions in coal liquefaction: Eighth quarterly report, June 1, 1987-August 31, 1987. Solomon, P.R.; Serio, M.A.; Deshpande, G.V. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). 1987. Contract FG22-85PC80910. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002728/JAW.

The major goal is to characterize the depolymerization and crosslinking reactions of low rank coals and determine how they can be optimized in liquefaction by combining high heating rates with solvent interactions. High heating rates are achieved by using a heated tube reactor. Crosslinking and depolymerization reactions are also being studied by using polymers to simulate the chemistry occurring in coal. A new batch of piperidine swelled lignite was made for pyrolysis studies in the heated tube reactor. About 26% of piperidine was incorporated into the lignite. Chars of carboxylated poly(2,6 dimethyl 1,4 phenylene oxide) and poly (2,5 dihydroxy 1,4 p-xylylene) were analyzed for functional group composition by quantitative FT-IR spectroscopy and for crosslink densities using solvent swelling with pyridine. For chars of the carboxyl polymer, there is a clear correlation between the decrease in intensity in the C = 0 stretch and the loss in solvent swelling. A similar decrease in the solvent swelling for hydroxyl polymer chars was not observed. Rank dependence on various output parameters of the FG-DVC model were obtained for a pyrolysis simulation. A correlation between degree of crosslinking prior to tar evolution and amount of tar evolved, the molecular distribution of the tar and char fluidity was obtained. 2 refs., 5 figs.

13955 (DOE/PC/90527—T4) Characterization of oxidized coal surfaces: Quarterly report, August 1987-October 1987. Hercules, D.M. (Pittsburgh Univ., PA (USA). Dept. of Chemistry). 1987. Contract FG22-86PC90527. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002554/JAW.

Work has progressed in the areas of: (a) exploration of derivatization reactions for ambient temperature in situ derivation of phenols, alcohols, and acids on carbon surfaces; (b) analysis of the derivatives by secondary ion mass spectrometry (SIMS), principally, and laser mass spectrometry (LMS); and (c) completion of the basic construction of the reactor for controlled oxidation of coal. Specific derivatizations studied during this period included reactions of 4-triethyl-ammonium-1-chloro-2-butene (TAB), trimethylsilyl ethers (TMS), and dimethylsilyl ethers (DMS) with phenols and alcohols, and TAB and pentaflorobenzylesters (PFB) with acids. Positive ion SIMS analysis of TAB derivatives of both phenols and acids yield molecular ion species (e.g., cations from the salts). The TAB derivatization is highly specific for phenols if the reaction is performed at high pH and for acids if the reaction is performed at a low pH. Molecular ion species have been observed in positive SIMS analysis of TMS derivatives. However, DMS derivatives have not yielded useful information in SIMS analysis under any conditions studied. 5 refs., 9 figs.

13956 **(DOE/PC/90959—T4) Microscopic modeling of sound waves in granular material: Quarterly progress report, October 1, 1987-December 31, 1987.** Haff, P.K. (California Inst. of Tech., Pasadena (USA)). 1987. Contract FG22-86PC90959. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000348/JAW.

In previous work we have studied via computer simulation the transmission of elastic disturbances through a quasi-consolidated grain mass, as well as through a mass of particles undergoing shear deformation. In the past quarter we have been developing the capability of modifying our earlier quasi-consolidated studies, where periodic waves were generated by an oscillating boundary, in order to focus on the radiation of elastic energy from a single point down through a drain mass to a transducer at the bed. The oscillating boundary studies hinted at the importance of columnar structure in the grain fabric, but the lateral extent of the excitation transducer inhibited analysis of the role of individual grain columns. In the present work, a layer of grains is allowed to settle on a horizontal surface. A "cooling" algorithm is employed to speed the settling rate, which otherwise takes a substantial amount of computer time (more on this below). When the grains have come to rest, a sharply located pulse is injected at the surface of the bed, in the form of a downward impulse applied to a grain. The lowest layer of "particles" on the bed are monitored for the arrival of the wave resulting from the surface disturbance.

13957 **(DOE/PC/90960—6) Rheology of high concentration polymodal multiphase flow: Quarterly report.** Probstein, R.F. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1988. Contract FG22-86PC90960. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005166/JAW.

An analysis was carried out on the effect of shear rate on the viscosity of a commercial coal-water slurry supplied to us by PETC. Figure 2 clearly demonstrates an important characteristic of coal-water slurries. As the solids mass fraction is increased, the critical shear rate at which the viscosity becomes independent of the applied rate of shear strain, is decreased. Shown in Fig. 2, as the solids mass fraction is increased from 0.554 to 0.691, the critical shear rate is decreased by more than an order of magnitude. Moreover, the difference between the viscosity curves of different solid concentrations seems to increase with the shear rate. This can hardly be explained by colloidal theory. The answer, however, has a basis in the MIT bimodal theory which suggests that it is the colloidal part of the suspension that is responsible for the non-Newtonian behavior, while the coarse particles do no more than amplify this non-Newtonian viscosity. One must also realize that, in the presence of coarse particles, the shear rate experienced by the colloidal suspension is not the applied shear rate, but is a modified one based on lubrication concepts. We have dealt with this in our previous reports, where it was shown that the correction factor to the applied shear rate was strongly dependent upon the volume concentration of coarse particles at relatively high volume fractions, as is the case for the suspensions studied in the present work. 3 refs., 3 figs., 1 tab.

13958 **(IEACR—04) The mechanical properties of coke.** Kirchner, A.T. (International Energy Agency Coal Research, London (UK)). 1987. 21p. International Energy Agency Coal Research, London, UK.

One of the most important properties of coke produced for use in metallurgical processes is its strength; this has become increasingly important as the reserves of the best coking coals have been gradually depleted and as increasing economic pressures have caused the iron and steel industry to strive for greater efficiency. This report, based on a literature survey, outlines briefly some of the many factors which influence coke strength. Topics that have been covered include: coal rank; caking tests - Free Swelling Index and Gray-King tests; plastic properties of coal and their measurement by means of the Gieseler plastometer; mechanical strength tests - Micum, Tumbler, Shatter and Diametral Compression tests; high temperature properties of coke; petrographic composition and its effect on coke stability (strength), the Schapiro-Gray model; blending of differing coals to produce coke; use of petroleum additves to improve coke strength; porosity and pore-wall structure; optical texture; and coke reactivity in the blast furnace - after reaction strength. 77 refs.

13959 **(NP—8751691) Max-Planck-Institute for Coal Research.** Emrich, U.; Gerwin, R. (comp.). (Max-Planck-Gesellschaft zur Foerderung der Wissenshcaften e.V., Muenchen (Germany, F.R.)). 1987. 169p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751691/JAW.

This jubilee edition on the occasion of the 75th birthday of the Max-Planck-Institute for Coal Research first gives a detailed historical survey of the life of the institute, which was devoted from the beginning to basic research, the scientific exploration of coal and to catalysis. A 'walkabout' around the present day institute explains the individual working parties and their technical orientations. The individual research fields are then explained in more detail, where homogeneous catalysis with chelate catalysts is one of the central subjects. Other subjects, apart from coal chemistry, are the synthesis of magnesium hydride and its use in Mg/MgH/sub 2/ hydrogen stores and destraction/extraction with supercritical gases.

13960 **Double cross polarization MAS/NMR in models and derivatized coals.** Hagaman, E.W.; Chambers, R.R.; Schell, F.M.; Woody, M.C. (Oak Ridge National Laboratory, TN (USA). Chemistry Division). pp 23-24 of 1987 international conference on coal science. Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers (1987). (CONF-871030—).

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

Describes a coal characterizatión method that involves chemical modification of coals and double cross polarization/magic angle spinning nuclear magnetic resonance analysis to provide correlated statistical structure and reactivity information. 2 refs.

13961 **Interpreting the characteristics of coal seams from chemical, physical, and petrographic studies of peat deposits.** Cohen, A.D.; Spackman, W.; Raymond, R. Jr. (Los Alamos National Lab., NM). pp 107-125 of Coal and coal-bearing strata: recent advances. Scott, A.C. (ed.). Oxford, England; Blackwell Scientific Publications (1987).

The purpose of this paper is to illustrate some of the kinds of information about coals that are at present being generated from studies of peat deposits and also to point out some possible new areas of research that might be undertaken in the future. Some notable examples of new ideas about coal seam composition or formation that have been generated from studies of modern peat deposits include: (1) discovery of the probable progenitors of certain coal macerals and elucidation of the processes by which they may have formed; (2) evidence that some types of mineral matter may be dissolved out of peat deposits; (3) verification of the role of marine waters in emplacement of sulfur in peat; (4) discovery of the importance of doming in peat deposit development; (5) discovery of a new way to form a split in a coal seam, i.e. development of a fire splay; (6) elucidation of the mechanisms responsible for producing stratification in coal seams; (7) recognition of the world-wide importance of back-barrier coal-forming environments. These kinds of discoveries are important in themselves; however, they can also be shown to have many additional practical applications, especially if woven into models to predict the economic characteristics of coal seams. 47 references, 12 figures, 1 table.

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REFER ALSO TO CITATION(S) 13918, 13929, 13977, 13978, 14032, 14499, 15524

13962 **(CRIEPI-T—86037) Motion of flyash particles in an electrostatic precipitator.** Watanabe, T. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1987. vp. (In Japanese). Central Research Institute of Electric Power Industry, Tokyo, Japan.

This paper describes the following two items to clarify flyash particle collection mechanism in an ESP; (1) Al analysis of flyash particle motion with a computer simulation; (2) The trajectories of flyash particles computed and observed by a visualization technique: A simulation program is based on the two-dimensional electro-hydro dynamics theory. The charges of a particle are calcu-

lated by the new calculation formula that has the parameter of the tuffs' density; when the tuffs' density is large, a particle soon deviates from a stream line and goes to a collecting plate; when the tuffs' density is small, a particle goes along a stream line and reaches to an outlet of an ESP unit; in the range of a particle diameter approx 50-0.01 upsilonm the calculated velocities directed to a collecting plate are in good agreement with the measured values; this simulation program is very useful for analysis of the collecting mechanism and estimation of collection efficiency in an electrostatic precipitator.

13963 (DOE/MC/10637—2414-Vol.1, pp 1-67, Paper 2) **Waste management: Final technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March 1987.** Moretti, C.J.; Henke, K.R. Apr 1987. NTIS, PC A12/MF A01. Order Number DE87006531/JAW.

In Low-rank coal research: Volume 1, Control technology, liquefaction, and gasification: Final report.

The Waste Management project is conducting research to characterize coal combustion solid wastes and to develop innovative liner materials for utility waste disposal sites. The objective of the waste characterization study is to assess the impact of solid waste disposal requirements on the commercial viability of several coal utilization processes being developed at the University of North Dakota Energy Research Center (UNDERC). The objective of the liner study is to develop cost-effective liner materials for utility waste disposal sites using mixtures of coal combustion fly ash, lime and/or cement. This report contains the results of characterization studies performed on 14 different waste materials produced from advanced coal combustion processes being developed at UNDERC. Studies were completed on 10 waste streams from the atmospheric fluidized bed combustion unit, 2 waste streams from combustion tests which used pressure hydrated lime injection for SO_2 control and 2 waste streams from combustion tests which used NH_3-SO_2 injection for enhanced particulate collection. The types of waste samples studied included fly ashes, spent bed materials, primary cyclone ashes, secondary cyclone ashes and ash composites. The test protocol used for the characterization studies consisted of waste analyses for elemental, mineral and trace organic content, waste leachate analyses for trace metals and trace organic compounds, and tests of physical properties relevant to waste disposal. The results of the waste characterization work indicated that the disposal of waste materials produced from processes being developed at UNDERC should not present any significant or unusual problems. 17 refs., 42 figs., 6 tabs.

13964 (DOE/PC/70770—T9) **Fundamental studies of the mechanisms of slag deposit formation: Studies on initiation, growth and sintering in the formation of utility boiler deposits: Topical technical report.** Tangsathitkulchai, M.; Austin, L.G. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). Mar 1986. Contract FG22-84PC70770;FG22-80PC30199. 386p. NTIS, PC A17/MF A01; 1; GPO Dep. Order Number DE88000739/JAW.

Three laboratory-scale devices were utilized to investigate the mechanisms of the initiation, growth and sintering process involved in the formation of boiler deposits. Sticking apparatus investigations were conducted to study deposit initiation by comparing the adhesion behavior of the ash drops on four types of steel-based heat exchanger materials under the conditions found in a utility boiler and an entrained slagging gasifier. In addition, the adhesion behavior of the ash drops on a reduced steel surface were investigated. All the ash drops studied in this investigation were produced from bituminous coals.

13965 (EPRI-EA—5499) **A review of the state-level Advanced Utility Simulation Model: Interim report.** Wood, D.O.; Baughman, M.L.; Berndt, E.R.; Fay, J.A.; Golomb, D.S.; Gruhl, J.; Kolstad, C.D.; Schweppe, F.C. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Dec 1987. 241p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920116/JAW.

This report review of the state-level Advanced Utility Simulation Model (AUSM) consists of six self-contained modules integrated into a single comuter program. The review examines each of the six modules to identify issues requiring further modeling research and analysis, and to provide potential users with information on using the model and on interpretation of model results. The Executive Overview provides a comprehensive description of the model, and summarizes the results of our review. Chapter 8 provides general comments from the modelers and model development sponsors. 71 refs., 8 figs., 12 tabs.

13966 (EPS—3-PG-7) **Evaluation of solid residues from atmospheric fluidized bed combustion, 1983/1984.** Constable, T.W.; Kissel, R. (Environment Canada, Ottawa, Ontario). Sep 1986. 98p. Environment Canada, Ottawa, Ontario.

A series of tests and analyses was conducted to examine the physical, chemical and leaching properties of solid residues produced at two Canadian atmospheric fluidized bed combustion (AFBC) installations: the Queen's University pilot-scale unit, and the first Canadian full-scale demonstration unit at Canadian Forces Base Summerside, P.E.I. Both units utilize eastern Canadian high sulphur bituminous coals for fuel and eastern Canadian limestone as a sulphur sorbent. This study is part of an on-going program by Environment Canada to develop protocols to characterize AFBC wastes and to develop waste handling, disposal and environmental protection practices for AFBC solid residues produced at coal-fired power generating stations in Canada. To date, the study has been limited to residues generated from the combustion of high sulphur content coals in limestone beds. The reactivity and exothermic nature of these residues, and the high alkalinity and total dissolved solids levels of their leachates, are a combination of properties that are unique to these AFBC wastes in comparison to conventional combustion wastes. These residues, therefore, require special consideration in the development of safe handling, disposal and environmental protection procedures. 17 refs.

13967 (EPS—3-PG-8) **Evaluation of solid residues from atmospheric fluidized bed combustion, 1984/1985.** Constable, T.W.; Sawell, S.E. (Environment Canada, Ottawa, Ontario). Sep 1986. 67p. Environment Canada, Ottawa, Ontario.

A series of tests and analyses was conducted on solid resiudes from two Canadian atmospheric fluidized bed combustion (AFBC) installations: the Queen's University pilot-scale unit; and the full-scale demonstration unit at Canadian Forces Base Summerside, P.E.I. Both units utilize eastern Canadian high sulphur bituminous coals for fuel and eastern Canadian limestone as the sulphur sorbent. Most tests and analyses were similar to those used in two previous studies to characterize the physical, chemical, exothermic and leaching properties of AFBC solid waste produced at coal-fired power generating stations. Additional tests were also employed to examine bulk density, unconfined compressive strength and column leaching. In general, the results of this study confirmed the findings of the previous studies. The results of the column leaching tests and field observations at the Summerside disposal area, however, suggest reactions may continue to occur over several months until the residues eventually solidify. The leachability of these residues, therefore, may be overestimated if only conventional batch leaching tests are used. The results indicate that the reisdues should be hydrated, dried (if necessary) to between 20% and 50% moisture, and compacted prior to final disposal in a landfill. 12 refs.

13968 (EPS—3-PG-10) **Some unique management characteristics of residues from atmospheric fluidized-bed combustion.** (Environment Canada, Ottawa, Ontario). Jun 1987. 105p. M.M. Dillon Ltd. (Canada).

The characteristics of the solid wastes from bubbling bed fluidized-bed combustion are under study to develop environmentally and economically optimal systems for waste collection, handling, transport, and disposal systems. Some waste characterization information may also be of benefit for refinement of the combustion technology itself. In this study, results of previous waste studies are re-evaluated on the basis of observations made at operating AFBC units. The observations focussed on ascertaining whether particular characteristics indicated in laboratory work were factors in day-to-day operations. The laboratory results and field observations were then synthesized and used to develop outlines for practicable waste handling and disposal as well as to identify remaining problem areas which might require further study. Several potential concerns

involving crystalline calcium oxide content and the effects of calcium oxide content on physical characteristics including exothermic reactions of the wastes were examined. However, no potential problems were identified which could not be overcome through the continued development of operational practices and technologies which took these characteristics into account. 43 refs

13969 **(KFK-PEF—26) Development of techniques for combined removal of dusts and gaseous pollutants.** Loeffler, F.; Gaeng, P.; Hedden, K.; Balekdjian, O. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Jul 1987. 158p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751703/JAW.

The simultaneous collection of dust and gases in fabric filters is a possible alternative to the well-known standard methods. During the course of filtration with fabric filters (e.g. bag filters), a filter-cake forms upon its surface and rapidly becomes the actual filtermedium, retaining particles over the complete size-range for which such filters are renownd. Under favorable conditions (e.g. adequate temperatures and residence time) this cake may also serve to separate gaseous pollutants such as SO/sub 2//SO/sub 3/, HCl and HF. Here, the extremely porous filter cake (ϵ proportional to 0,8) serves as a reactor for a gas-solid reaction with fine-particle alkaline sorbents (e.g. CaO, Ca(OH)/sub 2/, CaCO/sub 3/). This project is aimed at investigating high-temperature filtration with fabric filters under consideration of gas sorption within the filter cake. With 2 tabs., 79 figs., 105 refs..

13970 **(NP—8751684) Demonstration plant for building materials from coal preparation tailings. Final report.** Hoffmann, E. (Ruhrkohle A.G., Essen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Mar 1987. 105p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751684/JAW.

With hard coal production, inevitably stone from adjacent strata is brought to surface. This ballast matter referred to as 'dirt' is by approx. 69 pct. deposited on dumps. For ecological reasons, availability of the necessary surfaces is affected by increasing difficulties. From these results the necessity to find more possibilities of use for said dirt e.g. in civil engineering. Such a use, however, requires that quality standards bee met. One way to meet these quality standards is supposed to be thermal treatment of coal preparation tailings. On laboratory and pilot-plant scale the bases for this process engineering were established. The optimised temperature development and time for the necessary formation of the non-dehydratable phases of the argillaceous minerals in the washery tailings is known. In a pilot plant this process was optimized with consideration of measures for pollution control. This process engineering concept exhibits the required reliability in terms of process control and quality improvement. The economic viability, however, is not reached as yet because natural raw materials such as gravel and sand are in our region by approx. DM 40,-/t cheaper than treated washery tailings.

13971 **(NYSERDA—87-18) Coal Waste Artificial Reef Program: Reef measurements over four years in the sea: Final report.** (State Univ. of New York, Stony Brook (USA). Marine Sciences Research Center). May 1987. 89p. NYSERDA, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI88900264/JAW.

To improve our understanding of the interaction of the Coal Waste Artificial Reef in the marine environment, a monitoring study to collect additional data on the reef's physical properties, mineral phases, chemical changes and biological communities was carried out. The first phase of the program constructed a demonstration fishing reef in the Atlantic Ocean off Long Island, NY in 1980, using 15,000 blocks formed from waste materials generated by two modern coal-fired power plants. This report discusses the data obtained from the fourth year of interactions between the coal waste reef blocks and marine environment. Data collected to estimate block lifetimes were: physical properties, strength and elastic modulus of blocks along with changes in mineral phases and in chemical properties, leaching of major elements from the blocks and dissolution data. In addition, biological studies assessed block suitability as substrates for colonization by marine life typical of the reef's inshore location. The coal waste reef blocks were retrieved from the demonstration C-WARP reef site after four years of continued exposure in sea water and examined. The physical properties, compressive strength, density and elastic modulus (which also relate to block structure and strength) were essentially maintained compared to the original characteristics. Furthermore, there was no evidence of deterioration in structural integrity of the submerged blocks. From the results of the four year research program, it can be concluded that the stabilized coal waste reef blocks are: acceptable materials for ocean disposal; suitable for colonization and growth of high density and diverse aquatic communities; and without adverse effect in the sea environment. 20 refs., 20 figs., 15 tabs.

13972 **(VTT-TIED—741) Desulphurization wastes from coal-fired power plants.** Ranta, J.; Wahlstroem, M.; Ruohomaeki, J.; Haekkinen, T.; Lindroos, P. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1987. 151p. (In Finnish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751098/JAW.

In the desulphurization process of coal-fired power plants solid products are formed, which must be handled as waste due to their quality or small use potential. These are sulphite-rich products of the wet-dry process and ashes produced by fluid-bed and injection techniques, and gypsum developed in the wet process. According to the preliminary study, potential objects of utilization are primarily soil construction works, building material industries, later possibly also use as raw material conversion processes. At the first stage at least part must be placed in dumping areas. Uses in soil engineering are road constructions, building foundations, municipal engineering, earthfill dams, and heaping. The greatest drawback of these applications is the frost susceptibility of the material. Optimal handling methods are neither wellknown. Soil engineering applications are, due to their volume, the most significant form of utilization wastes. Possible applications in the building material industry are use as a component of cement, as a binding material or as a dry aggregate of concrete in the production of brick blocks and gypsum borads and pastes. However, the building industry will use desulphyrization products only restrictedly. The product of the gypsum process is fully equal to natural gypsum. A drawback of the end product of the wet-dry process is formed by soluble salts, primarily chlorides. Ways of mass handling are placing on dumps, filling of mines, and placing in the sea. The product of the wet-dry process must be consolidated by fly ash to reach a sufficient stability. The placing site must be environmental-technically acceptable. Possible impacts of desulphurization wastes on the environment would primarily be due to soluble salts and metals. However, the preliminary tests did not indicate any exceptional dissolution.

13973 **Flue gas desulfurization: materials for cyclic reheat systems.** *Materials and Components in Fossil Energy Applications;* No. 67, 5-7(1 Apr 1987).

The cyclic heat process consists of removing heat from the hot gases ahead of the scrubber and returning this heat to the flue gas downstream of the scrubber before it enters the stack. Of the various approaches to cyclic reheat, the gas-liquid-gas heat exchange system has received the most emphasis in the US. In this concept, a heat extractor in the scrubber inlet duct transfers heat to a working fluid which is circulated through a heater unit in the scrubber outlet duct. When the boiler is operated with a high-sulfur coal, the temperature of the heat extractor unit is below the dewpoint of sulfuric acid in the flue gas, so the unit must be made of corrosion resistant material. A field exposure program is being conducted in which various materials are exposed to the flue gas from a washed Illinois No.5 coal (containing 2-3% S) at the Scholz Steam Plant of Gulf Power Company. The materials investigate to date have included: (1) austenitic, ferritic, and duplex stainless steels, (2) nickel-base alloys, (3) alloys of zirconium and titanium. Carbon steel and cast iron were used for comparison purposes, although substantial wastage was anticipated. Non-metallic materials evaluated comprised polymeric coatings and porcelainized ceramics applied to carbon steel and Pyrex glass. This paper presents and discusses the results of the material testing. 2 figures.

13974 (DOE/OR/21400—H4-Vol.2-Pt.1) Utility FGD [flue gas desulfurization] survey, January-December 1985: Volume 2, Design performance data for operating FGD systems: (Part 1 of 2). Melia, M.T.; McKibben, R.S.; Jones, F.M. (PEI Associates, Inc., Cincinnati, OH (USA)). Apr 1987. Contract AC05-84OR21400. 748p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88003280/JAW.

The Utility FGD Survey report, which is generated by a computerized data base system, represents a survey of operational and planned domestic utility flue gas desulfurization (FGD) systems. It summarizes information contributed by the utility industry, system and equipment suppliers, system designers, research organizations, and regulatory agencies. The data cover system design, fuel characteristics, operating history, and actual system performance. Also included is a unit-by-unit discussion of problems and solutions associated with the boilers, scrubbers, and FGD systems. The development status (operational, under construction, or in the planning stages), system supplier, process, waste disposal practice, and regulatory class are tabulated alphabetically by utility company. Simplified process flow diagrams of FGD systems, definitions, and a glossary of terms are attached to the report. Current data for domestic FGD systems show 135 systems in operation, 15 systems under construction, and 56 systems planned. The current FGD-controlled capacity in the United States is 57,899 MW. This report, Volume II, Part 1, provides design and performance data for domestic FGD systems alphabetically A thru M (Minnkota).

13975 Cost effective technique for application of high alloys in FGD systems. *Materials and Components in Fossil Energy Applications;* No. 61, 7(1 Apr 1986).

Results obtained in recent years on the performance of corrosion-resistant alloys in critical areas of flue gas desulfurization (FGD) systems have shown that alloys such as Alloy C-276 can provide excellent protection. Such alloys are, however, expensive, especially in the thicknesses usually required for FGD components. A technique which provides a cost-effective way of applying these alloys, and which has performed very well in field trials, involves the welding of a thin (1.6 mm/63 mil) sheet of the highly protective material onto a thicker base plate of carbon steel or another suitable steel or alloy. Welds are made with comparable highly resistant alloy welding products. Weld quality and application procedures are critical to the success of this technique, but other important items are the preparation of the surface, especially if a field retrofit job is being considered, and the effect of thermal stresses and internal pressure on the interaction between the liner and the base metal. The performance of one application of this technique is discussed.

13976 Stabilization of coal cleaning waste by a granulation/sintering process. Gokhale, A.J.; Burnet, G. New York, NY; American Institute of Chemical Engineers (1986). 27p. (CONF-860826—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Technical Paper 84F.

Coal cleaning wastes are ground, granulated and sintered to form vitreous, impervious pellets capable of disposal without dusting, leaching or smoldering. The process utilizes the energy inherently present in the wastes. Fly ash and flue gas desulfurization sludge can be blended with the cleaning wastes for codisposal. Characterization and grinding of the wastes, the formation and testing of green granules for strength and durability, the design and operation of a fixed bed, batch sintering furnace, and preliminary evaluation of the sintered granules are discussed.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 13912, 13929, 14019, 16071

13977 (CRIEPI—485007) Study on the use of coal ash reclaimed land as upland-fields (Part 2). Okabe, K. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1987. vp. (In Japanese). Central Research Institute of Electric Power Industry, Tokyo, Japan.

Soil dressing on coal ash reclaimed land is a covering to use the land for agriculture. This study was carried out to find out the necessary depth of soil covering the ash layer in order to have normal crop growth. Two kinds of crops, Japanese radish, and rakkyo were planted in cover soil on the fly ash packed in wooden boxe (90 cm x 90 cm x 90 cm). Depths of cover soil were 20 cm, 30 cm, 40 cm and 50 cm. The results were summarized as follows: growth and yield of Japanese radish and rakkyo were increased with increasing depth of cover soil; root development of Japanese radish was inhibited at the lower coal ash layer. Main root length and edible root length of Japanese radish were decreased with decreasing depth of cover soil; boron and molybdenum contents in the plants remarkably increased with decreasing depth of cover soil. This may be due to the absorption of these elements from fly ash layer; it is concluded that optimum depth of cover soil should be more than 30 cm for Japanese radish cultivation and about 50 cm for rakkyo cultivation, respectively.

13978 (CRIEPI—486006) Studies on the temperature environment of experimental reclaimed land with fly ash. Kozakai, K. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1987. vp. (In Japanese). Central Research Institute of Electric Power Industry, Tokyo, Japan.

Thermal environments in the surface layer of the land reclaimed with fly ash were studied by using a small experimental system. The results are summarized as follows: the width of the daily soil temperature change at 8 cm under the surface layer of the fly ash land was about 4.5 C lower than that of the control which was reclaimed with volcanic ash soil in summer season. The depth that the daily soil temperature change could reach was 50 cm in the fly ash land and was 40 cm in the control; the width of the daily soil temperature change in the surface layer of the fly ash land covered with volcanic ash (both of 10 cm and 20 cm cover) was the same as the land reclaimed with only fly ash; the thermal conductivity of the fly ash land was 1.3 x 10^{-2} cm^2/sec and that of the control was 1.2 x 10^{-2} cm^2/sec. The soil moisture of the fly ash land was lower level than that of the control when the thermal conductivity was measured. It is accordingly assumed that the soil temperature of the fly ash land rises at deeper layer than that of volcanic ash soil land even when the soil moisture of the fly ash land is lower level.

13979 (NP—8751700) Mine spoils. Weathering and dissolution of mine dirt as illustrated by lysimeter experiments. Final report. Schmidt, R.; Schoepel, M. (Westfaelische Berggewerkschaftskasse, Bochum (Germany, F.R.)). Feb 1986. 480p. (In German). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88751700/JAW.

A lysimeter system with a meteorological station was set up in shafts 1/2 of Auguste Victoria mine in Marl-Huels, and the eighteen lysimeters were charged with railings originating from all German coal districts. Some lysimeters also received different sealing or filler materials, e.g. Emscher marl, loess loam, Haltern sands, calcareous mud, flotation waste, gypsum from flue gas desulphurisation systems, and PE plastics. One lysimeter was also covered with a layer of topsoil and grass. One lysimeter experiment was to investigate the weathering and dissolution of a fly ash from a coal mine. Further, the suitability of different materials as base seals under spoil dumps was investigated.

13980 (VTT-TUTK—469) Numerical simulation of peat dust explosions. Kjaeldman, L. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Mar 1987. 89p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751104/JAW.

The goal of this work was to develop a numerical model for peat dust deflagrations based on experiments done in a closed 20 dm3 spherical vessel. The gas-particle mixture is described as a continuous two-phase flow. The model includes drying, pyrolysis and combustion of the devolatilized gases and char. Local time dependent average values for the size and other properties of the particles are used. The results from the simulation are physically reasonable and promising. Reasons for the disagreements between the results from simulation and experiments are discussed and suggestions for further experimental research and model development are given. As

an application the explosion of dry peat dust in a vented vessel is simulated. The extension of the model to strongly heterogeneous mixtures with respect to particle size, moisture content or other properties is suggested and considered reasonable from both the modelling and computational points of view.

13981 **(VTT-TUTK—483) Leaching of metals from peat fly ashes.** Wahlstroem, M.; Pohjola, V. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). May 1987. 149p. (In Swedish). NTIS (US Sales Only), PC A07. Order Number DE88751090/JAW.

The aim of the study was to describe the long term impact from fly ash disposed on landfill. The quality of the leachate of three peat fly ashes and, as comparison on coal fly ash, was tudied by using batch leaching tests, column leaching tests, and large scale lysimeter leaching tests. The study comprised also ecotoxicological testing of the leachates. According to the results from the batch leaching tests, the water-soluble part of the fly ashes was about 2 to 3 per cent. The major components of the leachates were sulphate, potassium, sodium, calcium and chloride. Only small amounts of trace elements, mainly arsenic, molybdenum, and iron, were leached. No substantial difference between the two types of fly ashes (peat and coal) was noticed. The water-soluble amounts of the trace elements varied strongly for the different fly ashes. The pH-values of the leachates were neutral or alkaline and remained constant during the shake procedure. The first collected fractions from the columns and lysimeters contained the highest concentrations of most components. The concentrations in leachates decreased rapidly as a function of the increase of leaching water to the columns and the lysimeters. A few components (e.g. arsenic) showed a different leaching behaviour and the maximum concentration appeared at a later stage. The leachates from the columns and lysimeters showed very small toxic effects in the ecotoxicological tests. The toxic effects were highest in the initial leachate fractions. The leaching behaviour, especially in the column leaching test and the lysimeter leaching test, was similar for the fly ashes. The results from batch leaching test, which give less detailed information on the leaching behaviour, agreed well with the results from the column leaching test and the lysimeter leaching test. This indicates that laboratory tests, i.e. batch and column tests, can well be used to predict the leaching of components from fly ashes.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 13961

13982 **(GTK-TURVE—180) Studied peat resources and their potential use in Pielavesi municipality, Finland.** Luukkanen, A. (Geological Survey of Finland, Kuopio). 1986. 184p. (In Finnish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751148/JAW.

The Geological Survey is carrying out a total inventory of the peat resources of Finland. In the summer 1983 altogether 3 358 ha of mires were studied in Pielavesi municipality in Central Finland. The main purpose of this study was to find out fuel peat. Other uses of mires and peat deposits, such as production of horticultural peat, raw material for chemical processing, conservation and recreation were also considered. Most of the field work was carried out on a survey grid with study sites at intervals of 100 meters. At each site the following determinations were made and recorded: cover type, wetness of mire, amount and height of peat hummocks, density, size and quality of trees, peat type, humification degree, fibrousness and wetness and peat and the number of stumps and snags in the deposits. Laboratory samples were taken from selected sites for determining the ash content, water content, bulk density and heating value. In addition to peat type and degree of humification these data are essential in order to assess the usefulness of a mire. Altogether about 800 ha of peatland were considered suitable for fuel peat production. This is about 24% the mire area investigated. The amount of available fuel peat is about 16 millions of m/sup 3/ in situ.

13983 **(GTK-TURVE—181) Mires of the municipalities of Jaemsae and Jaemsaenkoski and their peat resources.** Korhonen, R. (Geological Survey of Finland, Kuopio). 1986. 161p. (In Finnish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751149/JAW.

The Geological Survey of Finland studied the mires and peat deposits in the municipality of Jaemsaenkoski in 1965, 1977, 1982 and 1983. The study is a part of the total inventory of the peat resources of Finland that Geological Survey is undertaking. In this report the material collected in the years 1977, 1982 and 1985 is been dealt with. The amin goal of the studies is to locate the peat resources with industrial interest main emphasis beeing on fuel peat production. Anyway, also other important wayes to use mires are taken into account, including conservation and recreation. The following surface characteristics were studied and recorded at each stake: the cover type and the wetness of mire, the amount and height of peat mounds and the density, size and quality of trees. After that the peat deposit was sampled from the surface to the bottom to determine the type, fibrousity, wetness and the degree of humification of peat. The amount of snags in the deposit was determined by pushing a two meters long rod ten times into the ground. Laboratory samples were taken from selected sites to determine the pH value, ash content, sulphur content, heating value, and bulk density of peat. Altogether 39 mires covering 1759 ha were studied. The area in which the peat is more than one metre deep is 1167 ha (66%), and more than two metres deep 695 ha (40%). A total area of 369 ha in 13 mires, containing useful peat reserves of 8.32 million cu. m, was judged suitable for industrial and small-scale production of fuel peat. In addition, limited areas in at least eight mires were deemed suitable for domestic fuel peat production.

13984 **(GTK-TURVE—182) Mires and their peat resources in Utajaervi. Pt. 1.** Pajunen, H. (Geological Survey of Finland, Kuopio). 1986. 195p. (In Finnish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751150/JAW.

The Geological Survey of Finland surveyed the area of 14 200 hectars of mires in the minicipality of Utajaervi during 1983-1984. The survey covered about 20% of the total area of peatlands in the municipality. The field work was carried out by using survey grid with study sites at the intervals of 100 meters. At each site the cover type, the peat type, the decomposition degree of peat, and the portion of dead, undecomposed trees in the deposit was determined and recorded. Altogether 1 170 peat samples were taken to the laboratory for pH, water content, and ash content determinations. Heating value was determined for 309 samples and sulphur content and fusion temperature of the ash for 51 samples. The area of 2 073 hectars was considered good for fuel peat production. The quantity of usable peat is 35.5 million cubic meters in situ. The energy content of the usable peat is 70 million GJ or 19.5 million MWh as calculated for dry peat.

13985 **(GTK-TURVE—183) Peat resources of the municipality of Vieremae and their potentialities in fuel peat production. Pt. 1.** Saarelainen, J. (Geological Survey of Finland, Kuopio). 1986. 222p. (In Finnish). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88751151/JAW.

The Geological Survey of Finland studied the mires and peat deposits in the municipality of Vieremae in 1984 and 1985. The study is a part of the total inventory of the peat resources of Finland that Geological Survey is undertaking. In this report the material collected in the year 1984 is been dealt with. The main goal of the studies is to locate the peat resources with industrial interest main emphasis beeing on fuel peat production. Anyway also other important ways to use mires are taken into account, including conservation and recreation. The detailed survey on a peatland was made using a survey line grid where the main line was run through the long axis of the deposit and through its center. A number of secondary lines were made perpendicular to the main line at 400 m intervals. The study sites were staked out at 100 m intervals. Depth measurements were made at 50 m intervals. The following surface characteristics were studied and recorded at each stake: The cover type and wetness of mire, the amount and height of peat mounds and the density, size and quality of trees. After that the peat deposit was sampled from the surface to the bottom to determine the type,

fibrousity, wetness and the degree of humification of peat. The amount of snags in the deposit was determined by pushing a two meters long rod ten times into the ground. Laboratory samples were taken from selected sites to determine the pH value, ash content, sulphur content, heating value, and bulk density of peat. Altogether 1341 ha of mires were evaluated good for fuel peat production. This is 25% of the surveyed area of 5411 ha. The amount of useful peat is 26.9 milj. m/sup 3/ in situ. The energy content is 47.8 milj. GJ or 13.3 milj. MWh.

13986 **(GTK-TURVE—184) Peat resources and their potentialities in peat production in the Lieksa area. Pt. 1.** Leino, J.; Kokko, J. (Geological Survey of Finland, Kuopio). 1986. 224p. (In Finnish). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88751152/JAW.

The Geological Survey of Finland made a peatland study in the town of Lieksa in 1981 and 1983. The study is a part of the total inventory of the peat resources of Finland. Seventy one mires were studied. They cover 7625 hectares, which is about 18% of the mire area which will be surveyed in Lieksa. Most of the field work was carried out on a survey grid with study sites at the intervals of 100 meters. At each site the following determinations were made and recorded: cover type, wetness of mire, amount and height of peat hummocks, density, size and quality of trees, peat type, humification degree, fibrousness and wetness of peat and the number of stumps and snags in the deposits. The average depth of the mires investigated is 1.2 m. The average depth of the over one meter deep areas is 2.0 m. They cover about 3500 ha. The average degree of humification is 5.1. The structure of deposits vary much from one mire to another. Altogether 277 samples were taken for laboratory determinations. The average ash content is 3.2% and the average efficient heating value 22.0 MJ/kg. The average dry matter content of the peat deposits is 95 kg per cubic meter of in situ peat, but there is a great variety even in the average values of different sampleseries: from 63 to 142 kg per cubic meter of in situ peat. Altogether 986 ha of peatland was evaluated as good for fuel peat production. The amount of fuel peat available is about 18 million cubic meters in situ. Some of these mires have thick slightly humified surfical layer that must be taken away before fuel peat can be produced. The amount of this slightly humified peat is 1.6 million cubic meters in situ.

13987 **(GTK-TURVE—185) Mires and peat resources of the commune of Haapajaervi and their potential use.** Korpijaakko, M.; Koivisto, M. (Geological Survey of Finland, Kuopio). 1986. 190p. (In Finnish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751153/JAW.

One of the tasks of the Geological Survey of Finland is to make an inventory of the useful peat resources of Finland. In this report the results of the mire and peat studies carried out in the municipality of Haapajaervi in the south of the province of Oulun laeaeni are dealt with. The mires selected in preliminary studies were surveyed using, survey line grids. They consist of a main line and secondary lines, perpendicular to it. The study sites are staked out at 100 m intervals in the lines. At each study site such features as cover type, wetness of mire, density and quality of tree stand were determined first. Then the peat deposit was studied from the surface to the bottom. Samples were taken with a Russian type peat sampler (Macaulay sampler). Peat type was determined according to its botanical origin and the degree of humification on v. Post's ten scale. A volumetric peat sampler was used to take peat samples from selected sites to determine water content, bulk density, ash content, heating value and sulphur content of peat. Based on the results obtained, 1460 ha of mire was estimated good for fuel peat production. This is 17% of the surveyed area of 8560 ha. Areas good for production of horticultural peat were not found. An area of about 600 ha was recommended for conservation or to be left for recreational use.

13988 **(GTK-TURVE—186) Peat resources of Vehkalahti municipality and their potential use.** Maekilae, M.; Grundstroem, A. (Geological Survey of Finland, Kuopio). 1986. 198p. (In Finnish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751154/JAW.

Geological Survey of Finland investigated the quantity and quality of the industrially exploitable peatlands in the municipality of Vehkalahti, Southeastern Finland, during 1984. Altogether 3 502 hectares of peatland were studied. This area cowers 5.3% of the municipalitys land area. The total peatland area suitable for fuel peat production is 570 hectares. Useful peat resources are 13.49 million m/sup 3/ in situ. The energy content equals to 4.35 million MWh as calculated for 50% moisture content. The area suitable for horticultural peat production is 720 hectares, containing about 9.00 million m/sup 3/ of peat in situ. The average depth of peat deposits is 2.19 m, including 1.05 m of slightly humified surfical layer. The total amount of peat of the studied peatlands is 76.7 million m/sup 3/. Area deeper than 2 m contains 60.4 million m/sup 3/ or 78.7% of the total reserves including 30.3 million m/sup 3/ of better humified peat. 55% of the peat layers are Sphagnum predominant and rest of the peat is Carex predominant. The average net calorific value of dry peat is 20.5 MJ/kg and 9.1 MJ/kg when calculated for 50% moisture content. The average bulk density of the samples is 69.4 kg/m/sup 3/ in situ, moisture content 92.7% of wet weight, pH-value 4.3, ash content 2.7% on dry bases and sulphur content 0.19%. Rajasuo (22) belongs to The National Mire Preservation Programme.

13989 **(GTK-TURVE—187) Peat resources and their suitability in the area of Rovaniemi. Pt. 1.** Muurinen, T. (Geological Survey of Finland, Kuopio). 1986. 199p. (In Finnish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751155/JAW.

The Geological Survey of Finland carried out peat resources on an area of 11,585 hectares of peatland in the municipality of Rovaniemi. The main emphasis was to find peat for energy use, but other uses of mires and peat deposits were also considered. The field work was carried out using survey grid with study sites at the intervals of 100 meters. At each site the cover type, the peat type, the decomposition degree of peat and the portion of dead, undecomposed trees in the deposit was determined and recorded. Altogether 1,061 peat samples were taken to the laboratory for pH, water content and ash content determinations. Heating value was determined for 1 024 samples and sulphur content for 178 samples. About 1,700 hectares of peatland with a minimum depth of 1.5 meters was considered good for fuel peat production. The quantity of usable peat is 35.46 million cubic meters in situ. The energy content of the usable peat is 58.54 million GJ or 16.28 million MWh with the water content of 50%.

13990 **(GTK-TURVE—188) Mires and their peat resources in Vihanti. Pt. 2.** Virtanen, K.; Herranen, T. (Geological Survey of Finland, Kuopio). 1986. 212p. (In Finnish). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88751156/JAW.

The Geological Survey of Finland studied the area of 16,280 hectars of mires in the municipality of Vihanti during 1975, 1982, 1983. The study is a part of the total inventory of the peat resources of Finland that the Geological Survey is making. In Vihanti all the mires of industrial interest was studied. The detailed surveys were made using survey line grids, where study sites were staked out at 100 meters intervals. The cover type, the peat type, the decomposition degree of peat and the substratum of the mire were determined at each study site. Laboratory samples were taken from selected sites to determine the pH value, ash content, heating value and bulk density of peat. Samples were also analysed for some trace elements. Altogether 3,392 ha of mires were evaluated suitable for peat production. The amount of useful fuel peat is 44 milj. m/sup 3/ in situ and the amount of useful horticulture peat is 4 milj. m/sup 3/ in situ. The energy content of fuel peat is 26 milj. MWh on dry basis.

13991 **(GTK-TURVE—189) Mires and their peat resources in Utajaervi. Pt. 2.** Pajunen, H. (Geological Survey of Finland, Kuopio). 1986. 112p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751157/JAW.

The Geological Survey of Finland surveyed mires in the municipality of Utajaervi in 1985. The total area of the mires is 6085 ha. The field work was carried out by using survey grid with study sites at the intervals of 100 meters. At each site the cover type, the peat type, the decomposition degree of peat, and the portion of

dead, undecomposed trees in the deposit was determined and recorded. Altogether 468 peat samples were taken to the laboratory for pH, water content, and ash content determinations. Heating value was determined for 120 samples, sulphur content for 40 samples and fusion temperature of the ash for 12 samples. The area of 1305 hectars was considered good for fuel peat production. The quantity of usable peat is 24.21 million cubic meters in situ. The energy content of the usable peat is 48.0 million GJ or 13.3 million MWh as calculated for dry peat.

13992 **(GTK-TURVE—191) Peat resources of Virrat and their potential use.** Toivonen, T. (Geological Survey of Finland, Kuopio). 1986. 227p. (In Finnish). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751158/JAW.

The Geological Survey of Finland studied peat resources around town of Virrat in 1945, 1960 and 1984. The majority of the mires were investigated in 1984. Forty-nine mires covering a toal of 7420 hectares were studied. Together with the mires in peat production, this figure accounts fo some 70% of the total area covered by peatlands. The mires studied contain a total of 119.9 million m/sup 3/ of peat in situ. The mean depth of the mires is 1.60 m, including the poorly humified surface layer, which averages 0.41 m in thickness. The mean humification degree (H) of the peat is 5.6. Sixty per cent of the total peat, or 71.1 million m/sup 3/, is at a depth of over 2 m in an area covering 2465 ha. Fifty-seven per cent of the peat is Carex predominant, and the remaining 43% Sphagnum predominant. The majority of the mires are drained. The most common types of mire are Sphagnum mire with pines. The average ash content is 3.1% of dry weight, the water content 91.2% of wet weight, the dry density 86 kg per m/sup 3/ in situ, and the sulphur content 0.15% of dry weight. The effective calorific value of the dry peat is 21.0 MJ/kg. Twenty-seven of the mires studied are suitable for fuel peat production; none of them are suitable for horticultural peat production. The total area of mires suitable for fuel peat production is 1194 ha, the available amount of peat being 25.7 million m/sup 3/ in situ and the energy content at 50% moisture 12.1 million MWh. Five of the mires studied, with a total area of 2176 ha, are included in The Naional Mire Preservation Programme.

13993 **(GTK-TURVE—192) Mires and their peat resources in Pudasjaervellae. Pt. 5.** Haenninen, P. (Geological Survey of Finland, Kuopio). 1986. 128p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751159/JAW.

The Geological Survey of Finland surveyed 19 mires in the municipality of Pudasjaervi in 1985. The total area of the mires is 6840 ha. The field work was carried out by using survey grid with study sites at the intervals of 100 meters. At each site the cover type, the peat type, the decomposition of peat, and the portion of dead, uncomposed trees in the deposit was determined and recorded. Altogether 554 peat samples were taken to the laboratory for pH, water content, and ash content determinations. Heating value was determined for 466 samples and sulphur content for 59 samples. The area of 1202 hectars was considered good for fuel peat production. The quality of usable peat is 19.38 million cubic meters in situ. The energy content of the usable peat is 36.53 million GJ or 10.16 million MWh as calculated for dry peat.

13994 **(GTK-TURVE—193) Mires and peat resources of the commune of Kerimaeki and their potential use. Pt. 2 and summary.** Leino, J. (Geological Survey of Finland, Kuopio). 1987. 241p. (In Finnish). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751161/JAW.

The Geological Survey of Finland made a peatland study in the Commune of Kerimaeki in 1978 and 1982-1985. The study is a part of the total inventory of the peat resources of Finland. Eighty two mires were studied. They cover 6126 hectares, which is about 11% of the land area of Kerimaeki. Most of the field work was carried out on a survey grid with study sites at the intervals of 100 meters. At each site the following determinations were made and recorded: cover type, wetness of mire, amount and height of peat hummocks, density, size and quality of trees, peat type, humification degree, fibrousness and wetness of peat and the number of stumps and snags in the deposits. The average depth of the mires investigated is 1.8 m. The average depth of the over one meter deep areas is 2.2 m. They cover about 4400 ha. The average degree of humification is 5.7. The structure of deposits vary much from one mire to another. Altogether 284 samples were taken for laboratory determinations. The average ash content is 3.0% of dry matter. The average dry matter content of the peat deposits is 105 kg per cubic meter of in situ peat. The values vary from 43 to 216 kg per cubic meter. Altogether 807 ha of peatland was evaluated as good for fuel peat production. The amount of fuel peat available is about 15 million cubic meters in situ. Two mires have a thick slightly humified surficial layer that can be used for production of horticultural peat. The amount of this peat is 0.6 million cubic meters in situ. An area of about 612 ha is reserved to be conserved.

13995 **(GTK-TURVE—194) Mires and their peat resources in Haapavesi. Pt. 1.** Virtanen, K.; Herranen, T. (Geological Survey of Finland, Kuopio). 1987. 138p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751160/JAW.

The Geological Survey of Finland studied the area of 14,453 hectars of mires in the municipality of Haapavesi. The detailed surveys were made using survey line grids, where study sites were staked out at 100 meters intervals. The cover type, the peat type, the decomposition degree of peat and the substratum of the mire were determined at each study site. Laboratory samples (227) were taken from selected sites to determine the pH value, ash content, heating value and bulk density of peat. Samples were also analysed for sulphur. Altogether about 4,000 ha of mires were evaluated suitable for peat production. The amount of useful fuel peat is 83,5 milj. m/sup 3/ in situ. The energy content of fuel peat is 44 milj. MWh on dry basis.

13996 **(GTK-TURVE—195) Peat resources of the municipality of Vieremae and their potential use. Pt. 2.** Saarelainen, J. (Geological Survey of Finland, Kuopio). 1987. 230p. (In Finnish). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751162/JAW.

The Geological Survey of Finland studied the mires and deposits in the municipality of Vieremae in 1984 and 1985. The study is a part of the total inventory of the peat resources of Finland that Geological Survey is undertaking. In this report the material collected in the year 1985 is been dealt with. The main goal of the studies is to located the peat resources with industrial interest main emphasis beeing on fuel peat production. Anyway, also other important ways to use mires are taken into account, including conservation and recreation. The detailed survey on a peatland was made using a survey line grid where the main line was run through the long axis of the deposit and through its center. A number of secondary lines were made perpendicular to the main line at 400 m intervals. The study sites were staked out at 100 m intervals. Depth measurements were made at 50 m intervals. The following surface characteristics were studied and recorded at each stake: The cover type and wetness of mire, the amount and height of peat mounds and the density, size and quality of trees. After that the peat deposit was sampled from the surface to the bottom to determine the type, fibrousity, wetness and the degree of humification of peat. The amount of snags in the deposit was determined by pushing a two meters long rod ten times into the ground. Laboratory samples were taken from selected sites to determine the pH-value, ash content, heating value, and bulk density of peat. Altogether 766 ha of mires were evaluated good for fuel peat production. This is 18% of the surveyed area of 4 252 ha. The amount of useful pea is 13.9 million cubic meters in situ. The energy content is 25.2 million GJ or 7.1 million MWh.

13997 **(GTK-TURVE—196) Mires and peat resources of the commune of Ylivieska and their potential use.** Korpijaakko, M.; Koivisto, M. (Geological Survey of Finland, Kuopio). 1987. 90p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751163/JAW.

One of the tasks of the Geological Survey of Finland is to make an inventory of the peat resources of Finland. In this report the results of the studies carried out in the municipality of Ylivieska are dealt with. About 3680 ha of peatlands were studied using the standard methods of the Geological Survey of Finland. Peatlands for detailed ground surveyes were selected in a preliminary survey,

which included a review of the basic maps at the scale of 1:20 000 and reconnaissance trips to the field. Detailed ground surveyes were made using survey line grids, which consist of a main line and secondary lines perpendicular to it. The study sites were staked out at 100 m intervals in the lines. Depth measurements were made at 50 m intervals. Such features as cover type, wetness of mire, density and quality of tree stand were determined at each study site first. Then the peat deposit was sampled from the surface to the bottom. Peat type was determined according to its botanical origin and the degree of humification on v. Post's then scale. Volumetric peat samples were taken from selected sites to the laboratory to determine water content, bulk density, ash content, heating value and sulphur content of peat. The results are discussed on a bog by bog basis. Included are tables, detailed peatland maps and peat type and humification profiles. About 480 hectares of peatlands were estimated good for fuel peat production. This is 13% of the surveyed area (3678 ha). One deposit of the size of 200 hectares was juged good for production of both horticultural and fuel peat. One peatland of the size at 240 hectares is been conserved.

13998 **(GTK-TURVE—197) Peat resources of the municipality of Siilinjaervi and their potentialities in sludge dewatering and fuel peat production.** Luukkanen, A. (Geological Survey of Finland, Kuopio). 1987. 65p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751164/JAW.

The Geological Survey is carrying out a total inventory of the peat resources of Finland. About 330 ha of mires were studied in Siilinjaervi municipality in the middle of Kuopio province in the autumn 1983. The main purposes of this study were to find out peat suitable for sewega suspension and fuel peat. The mires were surveyed using survey line grids. They consist of a main line and secondary lines, perpendicular to it. At each study site such features as cover type, wetness of mire, density and quality of tree stand were determined first. Then the peat deposit was studied from the surface to the bottom. Peat type was determined according to its botanical origin and the degree of humification on V.Post's ten scale. A volumetric peat sampler was used to take peat samples from selected sites to determine pH, water content, bulk density, ash content and heating value of peat. Based on the results obtained, 59 ha of mire was estimated good for sludge dewatering and 42 ha of mire good for peat production.

13999 **(GTK-TURVE—198) Inventory of peat resources of Kittilae in 1984.** Muurinen, T. (Geological Survey of Finland, Kuopio). 1987. 78p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751165/JAW.

The Geological Survey of Finland carried out peat resources on an area 4707 hectares of peatland in the municipality of Kittilae. The main emphasis was to find peat for industrial use, but other uses of mires and peat deposits were also considered. The field work was carried out using survey grid with study sites at the intervals of 100 meters. At each site the cover type, the peat type, the decomposition degree of peat and the portion of dead, undecomposed trees in the deposit was determined and recorded. Altogether 505 peat samples were taken to the laboratory for pH, water content and ash content determinations. Heat value was determined for 447 samples. 1036 hectares of peatland with a minimum depth of 2 meters was considered good for peat production. The quantity of usable peat is 24.88 million cubic meters in situ. The energy content of the usable peat is 44.14 million GJ or 12.28 million MWh with the water content of 50%.

14000 **(GTK-TURVE—199) Peat resources of Maentyharju and their potential use.** Toivonen, T. (Geological Survey of Finland, Kuopio). 1987. 221p. (In Finnish). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88751166/JAW.

The Geological Survey of Finland studied peat resources in the commune of Maentyharju in 1985 and 1986. 56 bogs covering a total of 2776 hectares were studied. This is over 95% of the total peatland area. The bogs studied contain a total of 55.3 million m/sup 3/ of peat in situ. The mean depth of the bogs is 1.99 m, including the poorly humified surface layer, which averages 0.30 m in thickness. The mean humification degree (H) of peat is 5.8. The area deepes than 2 m covers 1207 ha and contains 69% of the total peat quantity (38,2 million m/sup 3/). Sixty-seven per cent of the peat is Carex predominant, and the remaining 33% Sphagnum predominant. The majority of the mires are drained. The most common site type is Sphagnum bog with pines. The average ash content of peat is 2.9% of dry weight, the water content 91.0% of wet weight, the dry bulk density 88 kg per m/sup 3/ in situ, and the sulphure content 0.22% of dry weight. THe effective calorific value of the dry peat is 21.4 MJ/kg. Sixteen bogs are suitable for fuel peat production; none of them are suitable for horticultural peat production. THe total area suitable for fuel peat production is 464 ha. The available amount of peat is 11.7 million m/sup 3/ in situ and the energy content at 50% moisture 5.5 million MWh.

14001 **(GTK-TURVE—200) Peat resources of Kotka and their potential use.** Maekilae, M.; Grundstroem, A. (Geological Survey of Finland, Kuopio). 1987. 101p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751167/JAW.

Geological Survey of Finland investigated the quantity and quality of the industrially exploitable peatlands in the town of Kotka, southeastern Finland, during 1985. Altogether 1478 hectares of peatland were studied. This area covers 5.5% of the towns land area. The total peatland area suitable for fuel peat production is 192 hectares. Useful peat resources are 4.28 million m/sup 3/ in situ. The energy content equals to 1.62 million MWh as calculated for 50% moisture content. The area suitable for horticultural peat production is 150 hectares, containing about 2.62 million m/sup 3/ of peat in situ. The average depth of peat deposits is 2.01 m, including 1.10 m of slightly humified surfical layer. The total amount of peat of the studied peatlands is 29.7 million m/sup 3/. Area deeper than 2 m contains 21.9 million m/sup 3/ or 74% of the total reserves including 8.8 million m/sup 3/ of better humified peat. 51% of the peat layers are Sphagnum predominant and rest of the peat is Carex predominant. The average net calorific value of dry peat is 20.0 MJ/kg and 8.8 MJ/kg when calculated for 50% moisture content. The average bulk density of the samples is 61 kg/m/sup 3/ in situ, moisture content 93.7% of wet weight, pH-value 4.1, ash content 2.0% and sulphur content 0.18% on dry bases. Mustajaervensuo and the northern part of Suurisuo belongs to The National Mire Preservation Programme.

14002 **(GTK-TURVE—201) Peat resources and their suitability in the area of Rovaniemi, Pt. 2.** Muurinen, T. (Geological Survey of Finland, Kuopio). 1987. 82p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751168/JAW.

The Geological Survey of Finland carried out peat resources on an area 4353 hectares of peatland in the municipality of Rovaniemi. The main emphasis was to find peat for energy use. The field work was carried out using survey grid with study sites at the intervals of 100 meters. At each site the cover type, the peat type, the decomposition degree of peat and the protion of dead, undecomposed trees in the deposit was determined and recorded. Altogether 414 peat samples were taken to the laboratory for pH, water content and ash content determinations. Heating value was determined for 207 samples and sulphur content for 161 samples. About 980 hectares of peatland with a minimum depth of 1.5 meters was considered good for fuel peat production. The quantity of usable peat is 18.91 million cubic meters in situ. The energy content of the usable peat is 31.88 million GJ or 8.74 million MWh at the 50% moisture content.

14003 **(GTK-TURVE—202) Suitability of impulse radar and radiowave moisture probe for measuring the amount and quality of peat.** Haenninen, P.; Lappalainen, E. (Geological Survey of Finland, Kuopio). 1987. 35p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751169/JAW.

During the past decade the Geological survey has strongly concentrated its work on the development of new electric measuring equipment for peat researches. The paper deals with the results of the use of an impulse radar, a radiowave moisture probe and an automatically location equipment. The radar gives information fast and in detail about the thickness of peat and the topography of min-

eral soil below the peat layers. It also shows the depth and composition of flarky places. By radiowave probe it is possible to measure the moisture content of peat already on the field. It also gives information of the bulk density and energy content of peat.

14004 **(GTK-TURVE—204) Peat resources of Pyhtaeae and their potential use.** Maekilae, M.; Grundstroem, A. (Geological Survey of Finland, Kuopio). 1987. 89p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751170/JAW.

Geological Survey of Finland investigated the quantity and quality of the industrially exploitable peatlands in the municipality of Pyhtaeae, southeastern Finland, during 1985. Altogether 2589 hectares of peatland were studied. This area covers 9.1% of the municipalitys land area. The total peatland area suitable for fuel peat production is only 13 hectares. Useful peat resources are 0.33 million m/sup 3/ in situ. The energy content equals to 0.16 million MWh as calculated for 50% moisture content. The area suitable for horticultural peat production is 123 hectares, containing about 2.35 million m/sup 3/ of peat in situ. The average depth of peat deposits is 2.63 m, including 1.67 m of slightly humified surfical layer. The total amount of peat of the studied peatlands is 68.2 million m/sup 3/. Area deeper than 2 m contains 56.9 million m/sup 3/ or 83.5% of the total reserves including 18.7 million m/sup 3/ of better humified peat. 58% of the peat layers are Sphagnum predominant and rest of the peat is Carex predominant. The average net calorific value of dry peat is 20.0 MJ/kg and 8.8 MJ/kg when calculated for 50% moisture content. The average bulk density of the samples is 68.8 kg/m/sup 3/ in situ, moisture content 92.8% of wet weight, pH-value 4.1, ash content 2.2% and sulphur content 0.27% on dry bases. Kaarlinsaarensuo, Papinsaarensuo, Suurisuo, Munasuo and Kananiemensuo belongs to The National Mire Preservation Programme.

14005 **(NMRDI—2-74-4630) Hydrothermal testing of San Juan Basin coal: Final technical report.** Lechner, T.M.; Robinson, C.W. (Public Service Co. of New Mexico, Albuquerque (USA); Energy Transition Corp., Santa Fe, NM (USA)). Dec 1987. 164p. New Mexico Research and Development Institute, Suite M, 457 Washington SE, Albuquerque, NM 87108. Order Number DE88900297/JAW.

A lot of applied research has been done on trying to extract mineral values from coal ash (typically the by-product of coal-fired electric generating stations) prior to the ash being disposed of, usually back-filled into the mine from which the coal originally came. Hydrothermal treatment of coal, a Battelle Columbus Division Laboratories patented process, represents a different approach toward the same objective. However, instead of attempting to remove mineral values from coal ash after it has been burned, its two-step approach involves liberating the ash from the coal prior to burning, then removal of the mineral values from the ash extracted from the coal. The basic methodology involves selective precipitation of specific materials from properly prepared mixtures of first coal and then ash. The project's multifaceted benefits, assuming overall success (technical feasibility and economic viability), include the potential for cleaner coal to burn (resulting in lower power plant emissions), reduced ash handling at the power plant, a new kind of coal product for export from the region or for further enhancement through pyrolysis converting it into other fuels, and production of raw materials for resale or to be used as a feedstock to new industries for the area. The thrust of this research project was to evaluate Battelle's process, as applied to San Juan Basin Coal, and determine the overall potential for constructing an integrated processing facility.

0120 Mining

REFER ALSO TO CITATION(S) 14413

14006 **(BMFT-FB-HA—86-022) Climatization in coal faces in thin seams through air-drying. Final report.** Seidel, D.; Ritter, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Ruhrkohle A.G., Essen (Germany, F.R.)). Dec 1986. 91p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751674/JAW.

The project had for objective to climatize the entire intake mine air of a coal face by a drying system in order to avoid critical temperatures at the face end without cooling devices within the face and without any deteriorations of ergonomic conditions at work sites in the near upstream of the cooling plant by unacceptably low temperatures. To reach this effect a mobile deep freeze plant with subsequent reheating unit was developed, consisting of two constructional units arranged one behind the other, but switched in parallel. Upon extensive test rig runs paralleled by technical improvements the integral plant was subjected to underground trials in a coal face with homotrapal air flow. While maintaining ergonomically acceptable climate levels around 20degC dry and 10degC effective temperature ahead of the face the effective temperature at the face could be kept by 5 K/sub eff/ below that of uncooled mine air. The thermal limitations of mine air drying were analyzed on the basis of several case histories. The method proved to be technically mature and offers a present-day solution to climatization problems with coal faces where high temperature levels prevail, particularly in narrow space conditions due to low seam thickness where no other cooling measures what ever can be implemented in the face properly speaking. With 18 refs., 9 tabs., 30 figs..

14007 **(BMFT-FB-T—86-243) Development of a trackless vehicle transport system continuing from the surface through to the underground mining area. Final report.** Gierhardt, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Ruhrkohle A.G., Essen (Germany, F.R.)). Dec 1986. 145p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751673/JAW.

Based on the positive results obtained in other mining branches by the use of trackless transport vehicles, it was intended to design a continuous and comprehensive trackless transport system from the surface to the underground mining area of Fuerst Leopold/Wulfen mine. To ensure the high financial risk to be incurred, a calculation was carried out which compared the economics of trackless transport with conventional techniques. No economic advantage of a comprehensive use of trackless transport in the Wulfen underground area could be found out.

14008 **(BMFT-FB-T—86-249) Light-weight full face tunneling machine operating in stratum and rock formations of short-distance tunnels. Final report.** Horst, H.; Podelleck, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Mannesmann-Demag Baumaschinen, Duesseldorf (Germany, F.R.). Geschaeftsgruppe Lauchhammer - Bergwerktechnik). Dec 1986. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751676/JAW.

A light and compact full-face machine with 5.5 m boring diameter has been designed to permit a rentable driving of relatively short seam and rock sections. Besides the circular profile, an additional cutter head creates the possibility to make an arched profile. The possibility of changing the cutting wheels from inside the cutting head improves the safety of the personnel. Practical testing and trial will show whether the efficiency and working quality of the full-face technique, combined with the flexibility and mobility of the selective heading technique, prove to be a good choice. With 16 figs..

14009 **(BMFT-FB-T—86-251) Improvement, extension and acceleration of the planning of coal production in mines. Final report.** Koch, J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen (Germany, F.R.); Saarbergwerke A.G., Saarbruecken (Germany, F.R.)). Dec 1986. 15p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751675/JAW.

Drawing-up a planning system to assess quantitatively different alternatives for planning coal getting using any available information on technology and coal deposits, according to technical, capacitive, qualitative and economic criteria. The planning cycle is to be reduced by direct access to planning data bases and planning programs so as to be able to actualize planning, when new events

happen, within a short time in order to achieve a better utilization of underground machines, equipment and coal deposits. On the basis of the software product INFPLAN by Siemens a programme system was set up for cost planning broken down by allocation and operation areas/cost centres. A programme system entitled 'interactive mine planning', DIAPLAN, was set up and commissioned. Works for the graphic visualization of the planning basics were finalized. Using an LP-approach it was possible to solve the problem of selecting alternatives with the steps of capacity equalization and quality optimization. The planning process could be accelerated significantly so that in case of planning alterations new plans are available within days, compared to weeks preciously.

14010 **(BMFT-FB-T—86-252) Development and testing of a Gleithobel activated by high pressure waterjets. Final report.** Wille, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Ruhrkohle A.G., Essen (Germany, F.R.)). Dec 1986. 90p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751672/JAW.

Upon successful termination of preliminary investigations into the suitability of high pressure waterjets for cutting coal, Gewerkschaft Eisenhuette Westfalia, Luenen, and M.A.N.-GHH Sterkrade designed almost simultaneously, though independently, appertaining coal-getting equipment: The GEW design was based on nozzles arranged in the bits of a Gleithobel in order to afford jet-assistance of mechanical cutting operations, whereas GHH designed a completely novel type of winning equipment whereby the coal was undercut exclusively by means of fan-shaped oscillating waterjets and then broken out by stripping. Both of the methods were aimed at improving the cutting performance, reducing dust development and increasing the proportion of coarse coal in the ROM output. Activation of a Gleithobel by means of high pressure waterjets did not improve presently available cutting methods, at least not in a design as tested under the project. Trials using the GHH JETMINER were encouraging. It was decided, however, not to continue the trials since equipment for cutting and stripping coal-getting from the thin seams have by now been improved to such an extent that applications and marketing chances of the JETMINER have been drastically narrowed so as to exclude economic manufacturing of the equipment. With 2 tabs., 22 figs..

14011 **(BMFT-FB-T—86-257) Development, design, manufacture and trial of a face conveyor with optimal traction load diagram. Final report.** Seebacher, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Koeckner-Becorit G.m.b.H., Castrop-Rauxel (Germany, F.R.); Kloeckner-Becorit G.m.b.H., Recklinghausen (Germany, F.R.)). Dec 1986. 35p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751683/JAW.

According to the regulations of the 'Methodical Designing' we have developed a conveyor equipped with intermediate drives acting on a directly guided chain. These drives are to be placed at every 40 m as well as before and after bottom run, additional floor area is not required. This principle has been tried on a prototype having a narrow run in order to reduce the distance between support units and coal face. It was tested with load at the beginning of 1984. A part of the prototype (ca. 70 m) is at disposal of the Coal Mine Research and another part (ca. 135 m) shall be tried at the Prosper Haniel mine. With 14 refs..

14012 **(DOE/FE/00016—T133) Dust controls at longwalls with water infusion and foam: Technical progress report.** Pothini, R.; Hamilton, H. (Island Creek Coal Sales Co., Lexington, KY (USA)). 31 Dec 1987. Contract AI01-81FE00016. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88004386/JAW.

A study of the effects of shearer drum rotation on dust generation, product size, productivity, power consumption, machine reliability, and methane generation was undertaken in the Virginia Pocahonatas No. 1 mine. The study was made to determine the benefits, if any, achieved from the reversal of the head drum rotation from the normal direction (roof to floor) to the reversed direction (floor to roof). The operation of the shearer with reversed drum rotation proved superior. There was a 14% reduction in respirable dust on the up-wind side of the shearer and a 40% reduction on the down-wind side when the machine was operated with reversed rotation. Reversed rotation yielded an improvement of approximately 10% in the amount of coarse (+1/4 inch) material reaching the longwall conveyor belt. Time studies indicated a 13% improvement in productivity using reversed rotation. There was no discernible difference in the rate of power consumption. Reversed rotation data indicated a 22% reduction in methane generation per ton of coal mined during the cutting pass. Reversed drum rotation provided the benefits of a safer work environment (reduced respirable dust and methane generation), increased production (improvement in machine potential and availability), and improved product size. Reversed rotation should be considered a standard for all longwall shearers in the Virginia division and evaluated for use on the remaining longwalls within the company.

14013 **(EUR—11109-EN) Further development of vertical guidance system for shearers.** (Commission of the European Communities, Luxembourg). 1987. 498p. Commission of the European Communities, Luxembourg.

This ECSC-aided project was the continuation of development of automatic vertical guidance systems for shearer power loaders. The project included specification of the system, re-development of the necessary transducers, testing of all component parts of the system and testing of the system as a whole. Underground trials were carried out on the various mining methods and documentation was produced in the form of an updated operational specification, a handbook for installation sites and an extensive training package. The report covers some of the work carried out on the various aspects of the project and includes the latest operational specifications which is the culmination of much of the work (with regard to the underground part of the system). It is divided into three parts with appendices of underground installation reports and relative documentation. Part 1 explains the situation with vertical guidance prior to the project, the objectives of the project and some of the initial decisions made to produce a more flexible system with improvements in maintenance requirements and expert coverage. Parts 2 and 3 cover surface testing and the first underground trial.

14014 **(PB—88-119367/XAB) Critique of the dust-explosibility index: an alternative for estimating explosion probabilities. Report of Investigations/1987.** Hertzberg, M. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1987. 31p. (BM-RI—9095). NTIS, PC A03/MF A01.

Library of Congress catalog card no. 87-600078.

The Bureau of Mines report proposes a new methodology for estimating industrial dust explosion hazards in terms of three probabilities or cofactors: The dispersion of the dust, the existence of a flammable-dust concentration, and the presence of an effective source of ignition. The report presents a detailed critique of the deficiencies of an old, material-oriented index, and develops the logical rationale for its replacement by an approach that is better suited for quantitative hazard evaluations. A variety of such evaluations are illustrated, which show how a quantitative prediction of explosion frequencies can be obtained from laboratory measurements and operating conditions in a given industrial facility. The method has some pitfalls, particularly as they relate to the correlation of events or their randomness. These are discussed, as well as the method's other limitations and uncertainties.

14015 **(PB—88-120514/XAB) Water infusion for coalmine dust control: three case studies. Report of Investigations/1987.** McClelland, J.J.; Organiscak, J.A.; Jankowski, R.A.; Pothini, B.R. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1987. 24p. (BM-RI—9096). NTIS, PC A03/MF A01.

Library of Congress catalog card no. 86-607952.

This Bureau of Mines report discusses recent applications of water infusion technology to control dust in U.S. coal mines and presents recommended guidelines for determining coal-seam infusibility. The techniques required to use water infusion are presented in detail. A Bureau case study indicated that water infusion reduced dust levels by 68% along a longwall plow face, bringing this section into compliance with the 2.0-mg/cu m Federal dust standard.

Similar studies conducted by Occidental Research Corp. under a Bureau contract show that water infusion at two longwall double-drum shearer operations produced dust reductions ranging from 38 to 50%. Water infusion was found to be cost effective, averaging 5 cents per ton.

14016 **(PB—88-120613/XAB) Shield-loading studies at an eastern Appalachian minesite. Report of Investigations/1987.** Barczak, T.M.; Kravits, S.J. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1987. 90p. (BM-RI—9098). NTIS, PC A05/MF A01.

Library of Congress catalog card no. 87-600013.

Four longwall shield supports were instrumented with an eight-transducer instrumentation array to measure leg, canopy capsule, and compression lemniscate link forces from which resultant shield loading was determined. The instrumented supports were monitored over a 4-month period, producing over 75 shield cycles of resultant shield loading. Resultant loading is the true measure of support resistance, providing both roof-to-floor and face-to-waste support reactions as well as the location of the reaction on the shield canopy. Observed roof support reactions were analyzed, with particular emphasis on horizontal shield loading, since it is the least-understood design parameter. Average, peak, and change in shield loading during the mining cycle are discussed. Correlations among data parameters are examined, as is the distribution of support loading at the headgate and midface. Conclusions are drawn as to the effectiveness of the shield support at the installation. Recommendations are made for further research needs.

14017 **(VTT-TUTK—475) Properties and production methods for granulated peat production.** Lindh, T.; Perttala, T.L.; Erkkilae, A. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Apr 1987. 100p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751102/JAW.

The aim of the research project was to make milled and sod peat production methods closer to each other. In this way weather dependence could be reduced and better shrinkage properties achieved. The basic techniques of production and the properties of the granular peat product were studied. The methods are derived from modern milled and sod peat production, field granulation and pelletation methods. From another point of view all these production tec miques can be examined by studying physical, chemical and mechanical characteristics of granulated peat. Some new laboratory and field research equipment has to be developed and manufactured. These tools were used in experiments when searching for the best methods and technologies to harvest peat. In all of the tests of different methods and techniques there were found such technical parameters by which it was possible to make granules from different types of peat. The properties of granules made by all of these methods were quite similar to each other and moreover, with the properties of sod peat. Therefore in principle, any of the tested methods could be the basis for the future planning of the actual field equipment. In the experimented methods were to be arranged in order according to their capacity, the methods based on extrusion and adapted to the sod peat technology are the most promising.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 14499

14018 **(DOE/PC/90961—T4) Laser velocimeter measurements of solids in multiphase flow: Quarterly technical progress report covering the period June 1, 1987 to August 31, 1987.** Kadambi, J.R. (Case Western Reserve Univ., Cleveland, OH (USA)). 1987. Contract FG22-86PC90961. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000196/JAW.

Preliminary experiments were conducted to obtain pressure drop data for the slurry containing silica gel. Based upon this data, a Refractive Index Multiphase Flow Test Loop (RIMMTL) was designed. The details are provided. 5 figs.

0140 Combustion

REFER ALSO TO CITATION(S) 13910, 13926, 14036

14019 **(CRIEPI-W—86012) Emission characteristics of NO /sub x/ and unburned carbon with pulverized coal fired NR burner.** Nakata, T. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1987. vp. (In Japanese). Central Research Institute of Electric Power Industry, Tokyo, Japan.

In pulverized coal combustion the coal and air feeding systems have an effect on combustion characteristics. In other words, the NO/sub x/ and unburned carbon emission characteristics are largely influenced by the burner mechanism as well as coal properties. This study compares the pulverized coal fired NR burner with the SGR burner, particularly relating to NO/sub x/ and unburned carbon emission characteristics. The main results are as follows: the conversion rate of fuel N to NO/sub X/ is predicted by coal properties such as fuel N and fuel ratio; unburned carbon can be predicted by coal properties such as fuel ratio.

14020 **(DOE/MC/10637—2414-Vol.2) Low-rank coal research: Volume 2, Advanced research and technology development: Final report.** Mann, M.D.; Swanson, M.L.; Benson, S.A.; Radonovich, L.; Steadman, E.N.; Sweeny, P.G.; McCollor, D.P.; Kleesattel, D.; Grow, D.; Falcone, S.K. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Apr 1987. Contract FC21-86MC10637. 475p. NTIS, PC A20/MF A01; 1; GPO Dep. Order Number DE87006532/JAW.

Volume II contains articles on advanced combustion phenomena, combustion inorganic transformation; coal/char reactivity; liquefaction reactivity of low-rank coals, gasification ash and slag characterization, and fine particulate emissions. These articles have been entered individually into EDB and ERA. (LTN)

14021 (DOE/MC/10637—2414-Vol.2, pp 1-30, Paper 1) **Advanced combustion phenomena: First-year technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March, 1987.** Mann, M.D.; Swanson, M.L. Apr 1987. NTIS, PC A20/MF A01. Order Number DE87006532/JAW.

In Low-rank coal research: Volume 2, Advanced research and technology development: Final report.

Burning coal in a gas turbine combustor is not a new idea, but commercial success has not been achieved. The major technical problems inhibiting commercialization are: (1) deposits on the pressure and suction sides of the turbine blade reducing the gas flow area and turbine efficiency, (2) coal burnout during the short residence times inherent with gas turbine combustors, (3) corrosion of turbine blades by condensation of alkali sulfates, (4) erosion of turbine blades and other components by ash particulates entrained in the products of combustion, and (5) emissions control of NO/sub x/, SO_2 and particulates. The utilization of coal slurry fuels in medium speed diesel engines offers the opportunity to replace premium petroleum derived distillate fuels with more economical and abundant coal. Two major problem areas associated with the use of coal fuels in diesel engines are: (1) material wear and (2) slurry injection, ignition and combustion. The primary constraint on the practical use of coal slurries is their abrasiveness, due mainly to the presence of mineral components which are harder than the carbonaceous component of the coal. Coal-water slurries are now considered to be candidates as fuel for gas turbine and diesel engines. Until recently, low-rank coals were not considered for preparation of a coal-water slurry because of their high intrinsic moisture level which may exceed 35%. It is extremely difficult therefore, to prepare a pumpable slurry of as-mined lignite with a dry solid loading of over 35%. With the development of UNDERC's hot-water-drying (HWD) process, lignite and other low-rank coal slurries have been produced with solids loadings up to 62% and a heating value of 6800 Btu/lb of slurry. Subbituminous coals respond very well to hydrothermal treatment and produce high-quality slurries. 52 refs., 10 figs., 2 tabs.

14022 (DOE/MC/10637—2414-Vol.2, pp 1-43, Paper 2) **Combustion inorganic transformations: Final technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March, 1987.** Benson, S.A.; Radonovich, L.; Steadman, E.N.; Sweeny, P.G. Apr 1987. NTIS, PC A20/MF A01. Order Number DE87006532/JAW.

In Low-rank coal research: Volume 2, Advanced research and technology development: Final report.

The primary goal of Task 1 consisted of building a laser induced fluorescence spectrometer (LIFS) that is capable of measuring sodium atom fluorescence at appropriate concentrations and under conditions similar to those in coal burning flames. These conditions have been met and LIFS has been successfully used to measure the atomic sodium produced from NaCl solutions aspirated into methane-oxygen flame. In addition, preliminary measurements of sodium release from a North Dakota lignite have been made. Both horizontal and vertical temperature profiles were measured in order to study the temperature at various positions in the flame. The effects of sheath gas were also studied. The drop-tube furnace project has been undertaken as a means of studying the inorganic transformation mechanisms of fly ash formation that occur during coal combustion. A drop-tube furnace system has been constructed. It consists of a series of electrically heated tube furnaces that are vertically oriented. The system is modular in design so that the residence times can easily be changed by inserting and removing furnaces. The temperature controllers for each heated zone are interfaced with a personal computer for complete automation of the heat-up and cool-down procedures. A preheat/coal injection assembly was designed and constructed. It is capable of preheating the secondary air up to 1000°C and injecting coal plus primary air into the furnace hot zone. Several coal feed systems were tested and a plunger type feed system appears to provide the best feed rates. The fly ash quenching and collection systems have been tested. 38 ref., 20 figs., 6 tabs.

14023 (DOE/MC/10637—2414-Vol.2, pp 1-43, Paper 3) **Coal/char reactivity: Final technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March 1987.** Benson, S.A.; McCollor, D.P.; Kleesattel, D.; Grow, D. Apr 1987. NTIS, PC A20/MF A01. Order Number DE87006532/JAW.

In Low-rank coal research: Volume 2, Advanced research and technology development: Final report.

Studies have been conducted to determine the effects of organically-bound cations on the burning rates of char particles. Two coals, Beulah-Zap (ND) and New Mexico Blue, have been studied. The coals were demineralized and loaded with various cations including K^+, Ca^{++}, and Na^+. The burning rates for demineralized Beulah-Zap char was greatly reduced as compared to the untreated coal char. The reactivity was increased to that of the untreated chars after reloading with cations. The increased burning rates noted for some of those chars may be attributed to the promotion of CO_2 production by the catalytic activity of the organically-bound cations. Petrographic analysis of the Beulah-Zap chars were conducted to determine the effects of pretreatment (i.e., demineralization and cation loading) on the morphology of the char particles produced during rapid pyrolysis. The most obvious change in particle morphology was found in the char produced from the demineralized coal. The demineralized coal appears to become more plastic during rapid pyrolysis than the untreated coal as indicated by the large increase in the formation of cenospheres. Preliminary morphological studies have been conducted on the char residues collected at various heights from the injection point of the single particle reactor. The results have shown that the unfused and inertosphere morphotypes increase in relative abundance at higher heights in the reactor chimney. This is probably due to their relative low reactivity which inhibits ignition and combustion. A review of the literature on ignition phenomena was conducted. 52 refs., 11 figs., 16 tabs.

14024 (DOE/MC/10637—2414-Vol.3) **Low-rank coal research: Volume 3, Combustion research: Final report.** Mann, M.D.; Hajicek, D.R.; Zobeck, B.J.; Kalmanovitch, D.P.; Potas, T.A.; Maas, D.J.; Malterer, T.J.; DeWall, R.A.; Miller, B.G.; Johnson, M.D. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Apr 1987. Contract FC21-86MC10637. 222p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE87006533/JAW.

Volume III, Combustion Research, contains articles on fluidized bed combustion, advanced processes for low-rank coal slurry production, low-rank coal slurry combustion, heat engine utilization of low-rank coals, and Great Plains Gasification Plant. These articles have been entered individually into EDB and ERA. (LTN)

14025 (DOE/MC/10637—2414-Vol.3, pp 1-37, Paper 1) **Fluidized bed combustion of low-rank coals: First year technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March 1987.** Mann, M.D.; Hajicek, D.R.; Zobeck, B.J.; Kalmanovitch, D.P.; Potas, T.A. Apr 1987. NTIS, PC A10/MF A01. Order Number DE87006533/JAW.

In Low-rank coal research: Volume 3, Combustion research: Final report.

Low rank coals, lignite and subbituminous, offer particular advantages to combustion in fluidized beds. These include the high alkaline ash, with its sulfur absorbing capability, its nonagglomerating characteristics which reduce feeding problems, and its low cost widespread availability. Small scale industrial, commercial, and residential consumers are specific market targets. The goal of this project is to develop and expand the technical data base on the use of low rank coals in fluidized bed combustors. Particular efforts will be made to develop in this project, a predictive technique for bed agglomeration in FBC; corrosion and erosion of a variety of metals for boiler components; and the evaluation of combustor performance and environmental factors in operation on Low Rank Western Coals and fuel slurries. This report details the first year technical progress in the second three year program. The work has included bench scale studies of agglomeration, completing two tests each on a different coal of 1000 hour duration to evaluate corrosion and erosion in atmospheric fluid bed combustion (AFBC), and the extensive operational FBC characterization of a reference coal (Illinois No. 6) and a coal/water slurry produced from a subbituminous coal. The program in progress fills a direct need for basic information on the FBC characteristics of low rank coals. A variety of ash compositions exist, all of which directly influence maintenance and operability of a FBC omit. These data are vital to the commercial development of the technology. 15 refs., 16 figs., 11 tabs.

14026 (DOE/MC/10637—2414-Vol.3, pp 1-39, Paper 3) **Low-rank coal slurry combustion: Final technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March 1987.** Miller, B.G.; Johnson, M.D.; Selle, S.J. Apr 1987. NTIS, PC A10/MF A01. Order Number DE87006533/JAW.

In Low-rank coal research: Volume 3, Combustion research: Final report.

Slurry combustion research activities at the University of North Dakota Energy Research Center (UNDERC) began in 1983 and have continued with the support of the US Department of Energy (DOE). Coal research by DOE is directed toward increasing coal usage in existing markets and introducing new, premium quality coal-based fuels to markets currently dependent on oil or natural gas. The overall objective of this slurry combustion project is to expand the scientific and engineering data base on combustion of advanced low-rank coal (LRC) fuels for residential, commercial, and industrial processes by investigations into operational and environmental effects of burning slurry fuels made with LRC. In order to accomplish this, specific goals include a technology and market assessment, design of a LRC advanced combustion system, and development of the combustion system. A small-scale combustion system will be designed with small commercial buildings and apartment houses as the dominant application but with secondary applications for single-family homes. Accomplishments of the system design include a review of combustion technologies for residential

systems and the identification of environmental emissions performance. Combustion technologies evaluated include modifications of oil-fired systems, pulse combustion, fixed/packed beds, and Stirling engines. Upon evaluation of the technologies, a fixed/packed bed system was chosen for the design. A packed bed combustion system has several advantages for small-scale combustion processes. The bed contains ample surface area for combustion and maintains elevated temperatures for long periods of time. Ignition, response time, and turndown capabilities should function satisfactorily in a packed bed application. A preliminary set of performance goals has been established. 18 refs., 8 figs., 11 tabs.

14027 **(EUR—10765-FR) Optimization of the thermal state of the tuyere zone in the blast furnace.** Limpach, R.; Koster, J. (Commission of the European Communities, Luxembourg). 1987. 158p. (In French). Commission of the European Communities, Luxembourg.

In 1979/1980, blast furnace A of ARBED-ESCH/BELVAL was equipped with a pulverized coal injection plants. A research program was initiated to test a large range of solid fuels and to analyze the incidence of the different coals on BF performance, so as to be able to define decision criteria for optimizing BF operation as well as the economics of solid fuel injection. The research program aimed at a careful examination of the incidence of coal injection on the lower furnace, the upper furnaces and the overall operating results - coke rate, productivity, coke/coal replacement ratio. During the trials, 8 different solid fuels were injected with varying ash and volatile content. The trials were run under normal industrial operating conditions including changes in driving rate and in burden composition. None of the tested coals created technological problems in pipe transport and injection, and the blast furnace accepted well all the injected solid fuels. Coal injection increased operational smoothness, and the pig iron produced was of good physical and chemical quality. Even high ash coals did not impair slag quality and fluidity. Blast furnace productivity was not noticeably changed by solid fuel injection and it was therefore concluded that all solid fuels injected during the trials could be used as blast furnace fuels.

14028 **(LUTMDN/TMVK—5149-1-53-1986) PFBC-Concept combined with a Coal Gasification Process.** Staszewski, M. (Lund Univ. (Sweden). Dept. of Heat and Power Engineering). Aug 1986. 53p. NTIS (US Sales Only), MF A01. Order Number DE88751140/JAW.

The PFBC plant is a combined cycle which consists of a gas turbine cycle and a steam turbine cycle. The solid fuel coal is burnt in the fluidised bed. The exhaust gases from the combustor are utilized to drive the gas turbine, steam is raised in the steam generator, i.e. in boiler tubes in the fluidised bed. The efficiency of the PFBC plant is estimated to be about 41 per cent. It is limited by inlet gas turbine temperature - 850 degrees Centigrade. The gas turbine efficiency is strongly dependent on the inlet temperature. This work is an investigation of the performance of a modified PFBC unit. The coal consists of about 10-40 per cent volatile matter which is combustible. In the modified cycle the gasous components of coal are driven off and burnt in a separate fire-box. With this it is possible to attain a high inlet gas turbine temperature. A mathematical model of the devolatilisation process is constructed and put into a computer program. The attainable higher inlet turbine temperature is computed by the program.

14029 **Tube bank wastage in the Grimethorpe pressurized fluidized-bed combustor.** *Materials and Components in Fossil Energy Applications;* No. 67, 1-4(1 Apr 1987).

The coal-fired pressurized fluidized bed combustion (PFBC) at Grimethorpe, England, was run for over 3600 hours of combustion testing under the joint sponsorship of the governments of the Federal Republic of Germany, the United Kingdom, and the US. Early in the course of these tests, significant metal wastage was experienced, especially on the inbed heat transfer tubes. This paper describes the modifications to design and new alloys which were tested in the PFBC. Operating conditions for three tube banks are given. A new tube bank, D, has been designed which incorporates a variety of alloy types, a number of tubes designed to operate at higher temperatures than those typical of the rest of the tube bank, and some tubes fitted with fins. The datum fluidizing velocity has been reduced to 0.8 m/sec. The effects of these variables: metal surface temperature, alloy chromium content, fin or stud arrangements, and fluidizing velocity, will be investigated in a continuing program funded by British Coal and the Central Electricity Generating Board of the UK, with some participation from the US Department of Energy and the Electric Power Research Institute. 3 references, 5 figures, 1 table.

14030 **Distribution of high-temperature fireside deposits and corrosion in coal-fired boilers.** *Materials and Components in Fossil Energy Applications;* No. 67, 7-8(1 Apr 1987).

In the pursuit of increased efficiency of electricity generation, there is wide interest in the generation of steam at higher temperatures than are currently employed. The concomitant higher steam tube metal temperatures lead to fears of significantly increased fireside corrosion rates, with the prospect of degradation in boiler reliability. An investigation of the potential for high-temperature corrosion problems was conducted in two boilers of the Electric Power Development Company, Ltd., in Japan. In addition to the existing superheaters and reheaters, ultra superheater sections in the subcritical boiler were operated at 595 and 620°C. The coal burned contained 0.9-1.6% sulfur. Corrosion test probes were used to collect ash deposits and measure metal wastage throughout the supercritical boiler. Deposits also were obtained from heat exchange surfaces at similar points in the subcritical boiler. The compositions of the ash deposits at various points in the two boilers are shown. From results it was concluded that alloys with very high chromium contents are required for such high temperature boiler conditions. Coextrusion and chromizing offer practical means of achieving high surface chromium contents with ASME Code qualified alloys. 3 figures.

14031 **Prediction of remaining lifetime of superheater/reheater tubes in boilers burning high-sulfur coal.** *Materials and Components in Fossil Energy Applications;* No. 66, 1-3(1 Feb 1987).

The secondary superheater and reheater tubes in steam boilers are susceptible to a form of accelerated corrosion which is related to the formation of complex sulfates of sodium, potassium, and iron which may have melting temperatures as low as 552°C. The conditions required for this form of corrosion to occur include the deposition on the tubes of alkali- and sulfur- (and possibly iron-) containing species (from the coal), sufficient time and a temperature gradient in the deposit to allow the formation and migration of the corrosive species to the tube surface, and a tube surface temperature above the melting temperature of the complex sulfates. The factors that must be considered in a life expectancy calculation are: oxidation rate, molten salt corrosion rate, trisulfate melting point, original tube diameter, loss of outside diameter, internal scale thickness, and operating time. A computer program has been developed to carry out the life expectancy calculation based on these factors. This program was tested on the reheater of a 600 MW coal-fired boiler of General Public Utilities (GPU) which operates with 540°C and 4.83 MPa reheat. Tube sections were removed from the vertical section of the reheater for evaluation. The output indicated that after 90,000 hours the tubes would be thinned to 3.4 mm (135 mils), which agreed with actual measurements. Tube failure was predicted at 108,000 hours, when the tube wall would be reduced to 2.8 mm (111 mils). In this case tube replacement within two years was recommended to avoid forced outages. 3 figures, 1 table.

14032 **Coal ash corrosivity index for high-temperature alloys.** *Materials and Components in Fossil Energy Applications;* No. 66, 3-4(1 Feb 1987).

A method for estimating the corrosion rates of several high temperature alloys in a coal combustion atmosphere has been developed from an extensive study of boiler deposits, test probe deposits, and corrosion coupons exposed to synthetic coal ash in the laboratory. Deposits from 11 locations in a utility boiler - ranging from the lower furnace walls to the electrostatic precipitator entrance - were analyzed. The chemical composition of the deposits was compared with that of the coal ash. In addition, laboratory tests were conducted on Type 347 H stainless steel using salt mixtures to simulate deposits found in the boilers and in a typical coal combustion gas atmosphere. These tests demonstrated that the sodium and the potassium in the deposits promote corrosion and the calcium and

magnesium inhibit corrosion. The SO_2 content of the combustion gas also was shown to affect the corrosion process. The contribution of each of the corrosive and inhibitive components was determined in separate experiments. These experimental results led to an expression for the high temperature corrosion of Type 347H stainless steel under conditions likely to be experienced by secondary superheaters and reheaters. 4 figures.

14033 **Four utility fluidized-bed combustion projects approach demonstration status.** *Materials and Components in Fossil Energy Applications;* No. 65, 6-9(1 Dec 1986).

Fluidized bed combustors (FBCs) are being considered as viable options in an increasing number of applications where new power plant capacity is required and for schemes to extend the lives of existing power plants by retrofitting. Four large demonstration projects have been organized to allow evaluation of variations of this technology on a scale where essentially full-size components are employed. These four projects are: a 125 MW(e) atmospheric pressure fluidized-bed combustor retrofitted to Unit 2 of the Black Dog Station of Northern States Power Company near St. Paul, Minnesota; a 110 MW(e) circulating fluidized bed combustor at the Nucla Station of the Colorado Ute Electric Association, Inc. at Nucla, Colorado; a 160 MW(e) at the Shawnee Station of the Tennessee Valley Authority (TVA) at Paducah, Kentucky; and a 70 MW(e) pressurized fluidized-bed combustor at the Tidd Station of the Ohio Power Company (of AEP) at Brilliant, Ohio. The design, fuel, and schedule for each project are described. 10 references.

14034 **Evaluation of component performance in the TVA 20 MW FBC after 12,000 hours of operation.** *Materials and Components in Fossil Energy Applications;* No. 61, 1-5(1 Apr 1986).

During its first three years of operation (July, 1982 through July, 1985), the 20 MW AFBC boiler has been involved in four major campaigns of testing. The fuel used during all of these tests has been Kentucky No. 9, an eastern subbituminous coal with a sulfur content of approximately 4.1%. Two different sulfur sorbents have been used: Reed limestone (from July, 1982 through May, 1984) and Fredonia limestone. The superficial gas velocity through the bed has been 2.4 m/s for more than 90% of the operating time; the velocities used in the tests have ranged from 1.2 to 3.0 m/sec. Results of periodic inspections and measurements of the various boiler components, along with the evaluation of coupon materials exposed in the boiler, are discussed.

14035 **Video study of particle motion in a FBC.** *Materials and Components in Fossil Energy Applications;* No. 61, 6-7(1 Apr 1986).

A two-dimensional model fluidized bed, constructed of transparent polycarbonate, was used in a study of particle and bubble motion. The bed contained four rows of 1 cm diameter in-bed tubes mounted on a rectangular pitch with a horizontal spacing of 7.6 cm and a vertical spacing of 3.2 cm. Colored glass beads were used to simulate the bed materials, and motion in the bed was video-recorded at a framing speed of 1/30 sec. In summary, as a bubble approaches a tube, a cavity is first formed beneath the tube as the bed particles from this location fall onto the surface of the bubble. Then as the tube is engulfed by the bubble, bed particles streaming through the bubble impact the tube and fall into the wake of the bubble. These wake particles then impinge on the lower face of the tube as the bubble passes overhead, the velocity of impingement being equal to the rising velocity of the bubble. Erosive wear of the tube therefore appears to depend on the bubble size and generation frequency.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 13910, 14759

0160 Health And Safety

14036 **(CRIEPI-U—86017) Inhalation exposure of coal fly ash to laboratory animals.** Negishi, T. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1987. vp. (In Japanese). Central Research Institute of Electric Power Industry, Tokyo, Japan.

Inhalation effects of coal fly ash were investigated using young adult male golden hamsters. Animals were forced to inhale the coal fly ash for 180 days in the exposure chamber, at the concentration of 2 mg/m³, 20 hr/day, 7 days/week. Animals were examined hematologically, serologically and histopathologically at 30, 60, 90 and 180 days after the initiation of inhalation. Body weights and frequencies of breathing were not statistically different between the exposed and the control-group at any sacrifice time. Results of hematology and blood serum chemistry at 30, 60, 90 and 180 days of exposure seemed to have shown no health effects, but the number of polymorpho nuclear leukocytes in the blood of only the 180 days exposed group slightly increased as compared to those of the sham-exposed group. Respiratory organ and the other organs were examined pathologically. After 30 days of exposure, some small black spots of about 0.5 to 1 mm in diameter were seen in lungs, and after 60 days of inhalation more small spots were able to be observed in the mediastinal lymph nodes of exposed animals. These black spots in the lungs increased in number and increased in diameter in mediastinal lymph nodes with the duration of inhalation periods. Histopathologically, the black spots consisted of a number of alveolar macrophages laden with inhaled particles. Inhaled particles were not observed in other organs except respiratory organs.

02 PETROLEUM

REFER ALSO TO CITATION(S) 14772

0201 Reserves

14037 **Comparisons of computational efficiencies of different equations of state and transport property correlations in a compositional simulator.** Klara, S.M.; Hemanth-Kumar, K. (U.S. DOE/METC). pp 91-104 of Proceedings of the 1987 SPE annual technical conference and exhibition: Reservoir engineering. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870913—).

From Annual technical conference and exhibition of the Society of Petroleum Engineers; Dallas, TX, USA (27 Sep 1987). Technical Paper SPE 16942.

Comparison of computational time requirements for for equations of state and two viscosity correlation sets for several compositional simulation problems are presented. The results of this study indicate that when the reservoir oil is characterized using 3 components, 10 components, and 15 components, the computational time increases with the number of components. Furthermore, although no specific equation of state was the most efficient in all cases, a particular equation of state may show significant savings for a specific case.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 14101, 14326

14038 **(BMFT-FB-T—86-242) Berkhoepen 2001 - horizontal drilling research project with conventional drilling technology. Final report.** Prevedel, B. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Preussag A.G. Erdoel und Erdgas, Berkhoepen/Peine (Germany, F.R.). Arbeitsgebiet Tiefbohren). Dec 1986. 30p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751678/JAW.

Berkhoepen 2001 - horizontal drilling, research and development project with conventional drilling technology for an optimization of drilling, borehole-navigation and well surveying procedures. Main objective of PREUSSAG's R and D project, managed by Erdoel and Erdgas, Drilling and Service Department and partly financed by the Federal Ministry of Research and Technology, was the experience to drill similar wells for enhanced hydrocarbon recovery in the future less expensively, with less risk and with the highest confidence concerning borehole navigation and well surveying equipment. Results are important answers to questions like cutting transport, quality of cementation, casing wear during rotary drilling, magnetic behaviour of non-magnetic drill collars, experience with modern downhole motors and the extension of a computer simulation program for optimum stabilizer placement when drilling high-inclined and horizontal well sections. In the future Berkhoepen 2001 will be used as a training and test well to instruct service personnel and to develop and calibrate modern Preussag designed borehole instruments. With 14 figs..

14039 **(BMFT-FB-T—86-244) Investigation of the cutting transport in extremely deviated or horizontal boreholes by means of an experimental facility. Final report.** Steenbock, A.; Mueller-Link, D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Preussag A.G. Erdoel und Erdgas, Hannover (Germany, F.R.)). Dec 1986. 72p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751681/JAW.

Compared to vertical holes the conditions for cutting transport in extremely deviated or horizontal holes are unfavourable. The sedimentation of cuttings was evaluated by means of experimental facilities using different geometrics of the annulus, different mud types and a rotating or non-rotating drill string. The tests showed the necessity of turbulent flow in the annulus to prevent sedimentation. In the case of excentric positions of the drill pipe in the borehole this condition cannot be met for the whole annulus. Rotating the drill string causes a positive effect, because it supports turbulent flow. With 10 refs., 35 figs..

14040 **(BMFT-FB-T—86-247) Further development of a noise logging system. Final report.** Burkhardt, M.; Khan, F.A.; Mueller, K.; Dickel, U.; Dockhorn, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Geologie und Palaeontologie; Bergbau A.G. Westfalen, Dortmund (Germany, F.R.)). Dec 1986. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01 . Order Number DE88751679/JAW.

Acoustic vibrations can be measured with a suitable system through scanning the wall of an open hole and these vibrations can be analysed in frequency and amplitude. After testing this system with natural samples in laboratories it was tried for lithological correlation in shallow holes. A number of measurements were undertaken in shallow holes with different lithology. Scratch diagrams and caliper were registered and plotted. The peaks did not have any amplitude distribution depending on lithology and a correlation was not possible because of non-penetration possibility of the tracer and presence of mud-cake. Scratch noise analysis on hard clastic rocks did not enable reproducible results in situ as well as in labs. Alternation and possible destruction of hole wall through drilling process are responsible for such results. Investigations of drilling parameters such as bit, rotation, rock temperature, pH values of mud etc. could provide in future a better result. More data could be transmitted with introduction of light wave conductors. Lab and field measurements of caliper registration without touching the wall can be considered as successful. With 74 refs., 3 tabs., 56 figs..

14041 (NEI-NO—30, pp 18) **SISABOSA - a program for stochastic modelling and evaluation of reservoir geology.** Augedal, H.O.; Omre, H.; Stanley, K.O. (Saga Petroleum A/S, Oslo, Norway; Norwegian Computing Center, Oslo, Norway; Esso, Norge, Oslo Norway). 1986. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751203/JAW. (CONF-8609372—).

From Seminar on reservoir description and simulation with emphasis on EOR; Oslo, Norway (3 Sep 1986).

Co-sponsored by Scientific Software-Intercomp, London (UK).

SISABOSA is a computer program based on stochastic modelling of geologic parameters. It is designed to build three-dimensional sandstone reservoir representations, to calculate the volumes of reservoir sand bodies that are interconnected between wells, and to prepare three-dimensional representations for engineering simulations of the reservoir. SISABOSA can be used to identify potential problems, to identify critical geologic parameters and to make more accurate and quantitative reservoir characterizations. To date, the utility of SISABOSA has not been fully explored. However, the results of runs made on fluvial reservoirs are very encouraging. They indicate that complex reservoir hetereogeneities can be mimicked in SISABOSA representations and that sand bodies can be evaluated for continuity. They also show that more complex geologic models can be replicated and their input parameters risked to assess ranges in representations and computations made from them. In addition, the program can be used to evaluate how well pattern and spacing influences continuity of sand bodies in critical locations when interconnectiveness of sands strongly impacts on recovery. 8 figs.

14042 (NEI-NO—30, pp 16) **Lithofacies prediction from wireline log data.** Helgeland, J.; Mohn, E.; Omre, H. (Norwegian Computing Center, Oslo, Norway). 1986. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751203/JAW. (CONF-8609372—).

From Seminar on reservoir description and simulation with emphasis on EOR; Oslo, Norway (3 Sep 1986).

Co-sponsored by Scientific Software-Intercomp, London (UK).

An important step in well log analysis is to determine the lithology classes along the well. Classification techniques based on statistical pattern recognition may be applied to obtain this. The classifiers presented in this paper are based on various models for log response to lithology, including spatial dependence. A preliminary evaluation of three simple classifiers indicates that further refinements are necessary. Possible improvements of the underlying models are outlined. 4 refs., 5 figs., 1 table.

14043 (NEI-NO—30, pp 18) **Problem areas in applying advanced log analysis methods to reservoir description.** Moss, B.P. (Scientific Software-Intercomp, London, UK). 1986. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751203/JAW. (CONF-8609372—).

From Seminar on reservoir description and simulation with emphasis on EOR; Oslo, Norway (3 Sep 1986).

Co-sponsored by Scientific Software-Intercomp, London (UK).

Advanced log analysis methods are defined to be those that involve attempts to extract more details concerning the formation attributes than simple estimates of "shale", pore, and fluid volumes. Implementation of such methods encounters problems such as the lack of resolution, both vertically in the borehole and between minerals of interest in the rock, and problems in coping with the multiplicity of unknowns in log analysis and yet maintaining acceptably low levels of ambiguity in the results. The paper discusses these and related questions, and profers some ideas on how and if they are currently handled. 4 refs., 9 figs., 1 table.

14044 **Borehole creep closure measurements and numerical calculations at the Big Hill, Texas SPR storage site.** Preece, D.S. (Applied Mechanics Div. I, Sandia National Labs., Albuquerque, NM). pp 219-224 of Proceedings of the sixth international congress on rock mechanics. Accord, MA; A.A. Balkema Publishers (1987). (CONF-870815—).

From 6. International Society for Rock Mechanics congress; Montreal, Canada (30 Aug 1987).

The Bill Hill Texas salt dome is being developed as an additional site for the U.S. Strategic Petroleum Reserve (SPR). Ten deep (1433 m) boreholes were drilled in 1983 for leaching the first five storage caverns. Leaching has been delayed and the ten wells have been used to study the in-situ creep behavior of rock salt. Creep closure has been quantified by measuring wellhead pressure rise, volume of brine on pressure bleed-down and by performing caliper logs several years apart. Finite element calculations of borehole creep closure have also been performed. The calculated creep displacement of the borehole wall was used to compute volume change which could be used to compute wellhead pressure rise.

The calculated volume change and wellhead pressure rise were found to underpredict the field data by a factor of 2.5. The calculated displacements underpredicted measured borehole closures by a factor of 4.

14045 **Material balance calculations for solution-gas-drive reservoirs with gravity segregation.** Ambastha, A.K.; Aziz, K. (Stanford Univ.). pp 259-270 of Proceedings of the 1987 SPE annual technical conference and exhibition: Reservoir engineering. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870913—).

From Annual technical conference and exhibition of the Society of Petroleum Engineers; Dallas, TX, USA (27 Sep 1987).

Technical Paper SPE 16959.

In this work, a reservoir simulator is based to study the phenomena of gas percolation and gravity segregation, and their effects on reservoir performances. The sensitivity study of reservoir performance to block and time-step sizes show that for typical solution-gas-drive reservoirs, large errors in average reservoir pressure may result from improper control of time-step in the simulator. The authors propose a new material balance method for predicting the performance of thick, homogeneous, depletion-drive reservoirs. This method accounts for the vertical pressure and saturation gradients, and the secondary gas cap. The thickness of the secondary gas cap can be estimated with good accuracy using an idealized saturation profile. An iterative procedure relates average reservoir pressure to well pressure. The pressure and saturation at the well are then used to calculate the producing gas-oil ratio.

14046 **Finite population sampling methods for oil and gas resource estimation.** Kaufman, G.M. (Massachusetts Institute of Technology, Cambridge). pp 43-53 of Oil and gas assessment - methods and applications. Rice, D.D. (eds.). Tulsa, OK; American Association of Petroleum Geologists (1986).

Some recent developments in finite population sampling methods are applicable to oil and gas resource assessment. The objective of these models is to provide an estimate of the empirical frequency function of magnitudes of undiscovered deposits in a petroleum play when the only observable data are deposit magnitudes in the order of discovery (observation). The authors theme is the conceptual similarity of the well-known Arps and Roberts (1958) model for magnitudes of discoveries as a function of exploratory wells drilled to a finite population sampling scheme called successive sampling by statisticans. There are two types of approximately unbiased estimators for parameters of successively sampled finite populations: Gordon's (1983) moment matching estimator and Andreatta and Kaufman's (1983) anchored estimator. Both are similar in functional form to Arps and Roberts original estimator for the number of deposits of a given magnitude ultimately discoverable in a play, but arise from different assumptions about the nature of the sampling scheme. Using Western Gulf Miocene-Pliocene data and North Sea data, some estimates of empirical field size distributions generated by the three above-mentioned estimators are presented. When applied to Western Gulf Miocene-Pliocene data, the moment-matching estimator appears sensitive to how the sample is split. The anchored estimator replicates Smith and Ward's (1981) maximum likelihood estimates reasonably well.

14047 **North Slope Alaska oil-rock correlation study.** Hughes, W.B.; Holba, A.G.; Miiller, D.E. (Phillips Petroleum Co., Research and Development Dept., Bartlesville, OK). pp 379-402 of Alaska North Slope oil-rock correlation study: Analysis of North Slope crude. Magoon, L.B.; Claypool, G.E. Tulsa, OK; American Association of Petroleum Geologists (1985). (CONF-8302103—).

From Conference on the Alaska north slope oil-rock correlation study: analysis of north slope crude; Yountville, CA, USA (20 Feb 1983).

The major objective of the U.S. Geological Survey (USGS)-sponsored cooperative North Slope Alaska oil-rock correlation study was to establish, using a diversity of geochemical techniques, which formations(s) served as source(s) of the crude oils from the North Slope of Alaska. A second objective was to allow intercomparison and calibration of geochemical technologies among the university, petroleum industry, government, and private geochemical laboratories participating in the study.

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REFER ALSO TO CITATION(S) 14078, 14081, 14108, 15569

14048 **(BMFT-FB-T—86-261) Improvement of injectivity in water floods by use of chemicals in the enhanced recovery of petroleum production. Final report.** Oberkirch, W.; Neumann, H.J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bayer A.G., Leverkusen (Germany, F.R.); Institut fuer Erdoelforschung, Clausthal-Zellerfeld (Germany, F.R.)). Dec 1986. 22p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751682/JAW.

The effect of polymers and surfactants on the injectivity in core models was investigated. The objective were additives which help to eliminate injection problems in water floods. The procedure allowed experiments in laminar and turbulent flow. Results of linear core flood experiments were as follows: Cationic surfactants reduce flow resistance in single phase laminar flow. Non-ionic surfactants improve water injectivity via reduction of residual oil saturation. Polymers did not show any positive effect. Radial flow core floods and finally field tests will have to prove the feasibility of this concept in real systems. With 1 ref., 7 figs..

14049 **(CMI-R—852310-2) Reservoir economic optimization.** Nystad, A.N. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Mar 1985. 17p. (CONF-8503237—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751213/JAW.

From Society of Petroleum Engineer's hydrocarbon economics and evaluation symposium; Dallas, TX, USA (14 Mar 1985).

The paper outlines a reservoir-economic approach and quantifies the microeconomic adjustment of the exploitation of different types of petroleum reservoirs by means of a numerical optimization model. 11 refs., 23 figs., 2 tabs.

14050 **(CMI-R—852321-1) Evaluation of uncertain marginal petroleum projects. Pt. 1. Method and applications.** Stensland, G.; Haaberg, T. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Oct 1985. 70p. (In Norwegian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751214/JAW.

A survey is given of mathematical models for evaluation of uncertain petroleum projects. The models focus especially on the possibilities to adapt a project to the new information that is revealed during the progress of the project. 13 refs., 6 figs., 24 tabs.

14051 **(CMI-R—862325-1) Optimization models for oil and gas recovery.** Hallefjord, Aa.; Haugland, D.; Helgesen, C. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). May 1987. 66p. (In Norwegian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751193/JAW.

The subject of this report is models to optimize the production from oil and gas fields. A survey is given of the decisions that are made in the models. Results from experiments with two different models are presented. One of these models has a two-dimensional description of the reservoir, while the other has a zero-dimensional description and is called a tank model. The mathematical relation between the two models is given in an appendix. 7 refs., 23 figs.

14052 **(CMI-R—872090-5) Petroleum field development and the shut-down decision. An analytical model.** Aarrestad, J. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Jun 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751211/JAW.

An analytical model of a petroleum field is presented, where optimal installed capacity and shut-down time are determined simultaneously. Abandonment costs are included. The question of how changed economic conditions affect the companies' optimal choice of production capacity turns out to depend crucially on the lifetime of the field. The mode is richer in implications than a model where the shut-down decision regarded. On the other hand,

results are often less unambiguous. Numerical calculations may throw more light on the cases where the results are ambiguous. For this purpose the model is well suited. It can easily be programmed since it contains only physical and economy variables. However, the theory gives clear answers to some questions and indicates the problems where numerical calculations would be most useful. 4 refs., 4 figs.

14053 **(IKU-R—08.2698.00/01/87) Effects of aqueous phase on the recovery factor of oil.** Glasoe, Oe. (Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway)). Feb 1987. 35p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751112/JAW.

This report is a final report for the project "Effect of aqueous phase on the recovery factor of oil". Displacement experiments have been performed with reservoir oil from the Ekofisk field. The main purpose has been to study the effect of aqueous phase on the recovery factor of oil by miscible displacement with nitrogen as injection gas. The displacement experiments have been performed with and without aqueous phase present in the porous medium. Moreover, effect of the aqueous phase on the minimum miscible pressure (MMP) has been investigated. Experiments have also been performed in which the effect of the aqueous phase on the recovery factor of oil at pressure above MMP has been determined. 8 refs., 6 figs., 17 tabs.

14054 **(NEI-NO—30) Proceedings from the seminar on reservoir description and simulation with emphasis on EOR.** (Institute for Energy Technology, Kjeller (Norway)). 1986. 314p. (CONF-8609372—). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751203/JAW.

From Seminar on reservoir description and simulation with emphasis on EOR; Oslo, Norway (3 Sep 1986).

The conference proceedings contain 13 papers and in addition abstracts of 5 papers. The topics covered are: A marriage of geology and reservoir engineering. A program for stochastic modelling and evaluation of reservoir geology. The importance of carbonate cement in the formation of reservoir heterogeneities. Lithofacies prediction from wireline log data. Three dimensional reservoir description using well log and geological data. Problem areas in applying advanced log analysis methods to reservoir description. Statistical methods for wireline and core data analysis. New variations of chemical EOR and their economic potential. Fractal flow in 2- and 3-dimensional porous media. Modelling of geometry and processes in random media using micro-particles. Vectorization and parallelization of a reservoir simulator. The Rieman problem for a scalar hyperbolic conservation law in several space dimensions. Reservoir simulation by the method of front tracking. Simulation of laboratory displacement experiments. Review of some of the modelling problems associated with numerical simulation of surfactant displacement. Numerical and analytical solutions of a model describing polymer flooding. A moving point method for the numerical calculation of miscible displacement. On some aspects of history matching. Separate abstracts were prepared for 11 papers of the proceedings.

14055 (NEI-NO—30, pp 35) **Simulation of laboratory displacement experiments.** Aavatsmark, I. (Norsk Hydro, Bergen, Norway). 1986. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751203/JAW. (CONF-8609372—).

From Seminar on reservoir description and simulation with emphasis on EOR; Oslo, Norway (3 Sep 1986).

Co-sponsored by Scientific Software-Intercomp, London (UK).

A model for one-dimensional two-phase displacement in a core plug is presented. Different boundary conditions are necessary to handle flooding, gravity drainage and capillary inhibition. The resulting mathematical problem is analyzed and solved numerically. Some results are presented. 18 refs., 24 figs.

14056 (NEI-NO—30, pp 30) **Review of some of the modelling problems associated with numerical simulation of surfactant displacement.** Barker, J.W.; Fayers, F.J. (The British Petroleum Company, Sunbury, UK). 1986. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751203/JAW. (CONF-8609372—).

From Seminar on reservoir description and simulation with emphasis on EOR; Oslo, Norway (3 Sep 1986).

Co-sponsored by Scientific Software-Intercomp, London (UK).

This paper reviews some aspects of modelling surfactant system behaviour and some of the features that influence the design of surfactant floods for enhanced oil recovery (EOR) in North Sea conditions. The essential features of phase behaviour are described, together with the way these affect other physical properties, in particular the influence of capillary number on relative permeability. The equations of motion and some numerical techniques employed in existing surfactant reservoir simulators are briefly discussed, with particular reference to the control of numerical dispersion. An example is given of the application of these predictive methods to history matching surfactant displacement experiments in core flood tests at reservoir conditions. Two different assumptions on phase behaviour characteristics are shown to give nearly equivalent matches to the measurements, but with markedly different gravity segregation effects. The final example concerns the applicaton of a low concentraton process in a 5-spot pattern for a representative reservoir description, in which the changes in the threedimensional performance are illustrated when a polymer is added to the drive design. 20 refs., 25 figs.

14057 (NEI-NO—30, pp 17) **Reservoir simulation by the method of front tracking.** Daripa, P.; Glimm, J.; Grove, J.; Lindquist, B.; McBryan, O. (Courant Institute, New York University, USA). 1986. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751203/JAW. (CONF-8609372—).

From Seminar on reservoir description and simulation with emphasis on EOR; Oslo, Norway (3 Sep 1986).

Co-sponsored by Scientific Software-Intercomp, London (UK).

The front tracking method provides high quality solutions for problems with significant discontinuities. The application of this method to reservoir simulation is surveyed. Front tracking has been validated on reservoir simulation problems through the study of pattern floods. The method avoids the problems of numerical diffusion and grid orientation which affect conventional simulators. It gives good answers even on grids which are coarse relative to the problem complexity, as is required for typical complex engineering problems. It has been used for scientific studies of fingering, channeling and coning in oil, water and polymer processes. Current progress with this method is focused on more complex reservoir processes and on field scale simulation capabilities in two space dimensions. 14 refs., 10 figs.

14058 (NEI-NO—30, pp 17) **Numerical and analytical solutions of a model describing polymer flooding.** Johansen, T.; Tveito, A.; Winther, R. (Institute for Energy Technology, Kjeller, Norway; University of Oslo, Norway). 1986. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751203/JAW. (CONF-8609372—).

From Seminar on reservoir description and simulation with emphasis on EOR; Oslo, Norway (3 Sep 1986).

Co-sponsored by Scientific Software-Intercomp, London (UK).

The analytical solution of the Riemann problem for a 2 times 2 system of conservation laws, which models a polymer flooding process with adsorption effects, is discussed. Comparisons between the analytical solution and a standard finite difference solution are presented. The numerical experiments indicate that a very fine mesh has to be used for the upwind scheme, in order to obtain a good approximation to the exact solution of a Riemann problem. For a general initial value problem, greater difficulties are expected with the upwind scheme. The Random Choice Method (RCM) can be used to solve general initial value problems when the exact solution of the global Riemann problem is known. However, compared

to the upwind scheme, the RCM needs more computer time for a fixed grid and is more complicated to implement. 9 refs., 19 figs.

14059 (NEI-NO—30, pp 36) **Moving point method for the numerical calculation of miscible displacement.** Farmer, C.L. (Atomic Energy Authority, Winfrith, UK). 1986. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751203/JAW. (CONF-8609372—).

From Seminar on reservoir description and simulation with emphasis on EOR; Oslo, Norway (3 Sep 1986).

Co-sponsored by Scientific Software-Intercomp, London (UK).

A moving point method for improving the accuracy of fixed mesh algorithms for the solution of high Peclet number multidimensional convection-diffusion equations is described. This method automatically introduces moving points in regions where solutions are rapidly varying. The solution values associated with the moving points are used to correct the fixed mesh algorithm. Comparisons with exact solutions for one-dimensional linear flood and two-dimensional viscous fingering problems demonstrate the algorithm to be of high accuracy. 19 refs., 12 figs., 7 tabs.

14060 (NEI-NO—30, pp 15) **On some aspects of history matching.** Thomas, G.W. (Scientific Software-Intercomp, London, UK). 1986. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751203/JAW. (CONF-8609372—).

From Seminar on reservoir description and simulation with emphasis on EOR; Oslo, Norway (3 Sep 1986).

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A large number of reservoir simulator applications involve history matching. This is frequently done by ex post facto techniques, i.e. a large number of trial and error computer runs are executed with the known performance data being used after the fact, to deduce an acceptable set of input data. In so doing, one is using a differential equation solver to treat an inverse problem. This paper focuses on a direct method for treating the inverse reservoir simulation problem. The direct technique enables one to compute reservoir permeabilities and porosities in a single computer run utilizing appropriate data from several periods of the performance history. It is applicable to multiphase compressible flow in heterogeneous reservoirs. A procedure is described that recognizes, during the course of computation, whether or not a unique solution can be obtained. The method is capable of handling inconsistent data and constructing the best set of non-unique properties within realistic limits when unique solutions do not exist. The following conclusions may be drawn from the study: History matching, whether by a direct or ex post facto method usually involves an underlying ill-conditioned matrix problem; the results of history matching are meaningless if one fails to apply bounds to the adjusted input data, and fails to stay within the bounds; the idea that x years of history justifies only x years of predictions is fiction. How far one can confidently predict into the future is dependent more on the tightness of the bounds cited above, than on the elapsed history period. 4 refs., 8 figs., 1 table.

14061 (NIPER—278) **A comprehensive study on the effects of temperature, surface age, added surfactant, salinity, and bulk viscosity on coalescence time, film rigidity, and interfacial tension: Topical report.** Peru, D.A.; Lorenz, P.B. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Jan 1988. Contract FC22-83FE60149. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001211/JAW.

The interfacial behavior of a Wilmington crude oil was studied as part of our investigations of enhanced oil recovery by weakly alkaline solutions. For some systems, the spinning drop appratus can be used to measure transient interfacial tension (IFT) effects, coalescence times of oil drops, and film rigiditv simultaneously, for rapid screening of chemical slug composition for the potential of improving oil recovery by the mechanisms of oil mobilization and oil bank formation. The experimental results presented include the effects of temperature, surface age, salinity, added surfactant, and polymer on coalescence time, film rigidity, and IFT behavior. Oil displacement tests were performed using surfactant-enhanced bicarbonte solutions formulated for improved mobility control and for improved oil mobilization and oil drop coalescence. The most significant result of this work was that we were able to measure the dynamics in IFT between 2 coalescing oil drops as perturbations in the equilibrium concentration of surfactant at the interface occurred during film drainage. The accuracy of the technique for measuring IFT and film rigidity improved as the contact radii between the oil drops increased. 17 refs., 13 figs., 11 tabs.

14062 (NP—8751668) **Surfactant retention under reservoir conditions in enhanced oil recovery. Final report.** Ujma, K.H. (Preussag A.G. Erdoel und Erdgas, Hannover (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1986. 299p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751668/JAW.

The static adsorption measurements resulted in the construction of parts of an adsorption isotherm which has at equilibrium concentration a maximum of 5 to 6 mg adsorbed surfactant/g of rock substance, but exhibits a distinct minimum at higher surfactant concentrations. The phase equilibria in the system surfactant/synthetic oil phase/saline reservoir water exhibit a complex behaviour with up to 4 coexisting phases. The phase volumina, phase inversion temperatures, apparent viscosities, densities, and compositions (in part) of the whole system and the single phases, respectively, were determined at different oil-water-ratios and temperatures. The surfactant retention which was determined by measuring the surfactant concentration in the effluent of core flooding experiments amounted to 1...13 mg surfactant/g of rock substance, to 2...8 mg surfactant/g of rock substance if oil phase was present, respectivley. The relatively large retention figures are due to the chemical structure of the investigated surfactant and to the chosen experimental conditions. The surfactant retention in a whole system, i.e. in combination with polymer flooding, will presumably be much lower than the obeerved values. With 46 refs., 22 tabs., 177 figs..

14063 (PNL-SA—14733) **Reverse micelles and microemulsions in supercritical fluids.** Fulton, J.L.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 32p. (CONF-8706257—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005129/JAW.

From 61. colloid and surface science symposium; Ann Arbor, MI, USA (21 Jun 1987).

Reverse micelle and microemulsion solutions are mixtures of a surfactant, a nonpolar fluid and a polar solvent (typically water) which contain organized surfactant assemblies. The properties of a micelle phase in supercritical propane and ethane have been characterized by conductivity, density, and solubility measurements. The phase behavior of surfactant-supercritical fluid solutions is shown to be dependent on pressure, in contrast to liquid systems where pressure has little or no effect. Potential applications of this new class of solvents are discussed. 22 refs., 8 figs.

14064 **Well singularities in reservoir simulation.** Carey, G.F.; Chow, S.S. (Univ. of Texas, Dept. of Aerospace Engineering and Engineering Mechanics). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 2: No. 4, 713-719(Nov 1987).

In this study, the authors examine the problem of relating the computed solution at a well in reservoir simulation to the actual bottomhole pressure (BHP) and the related questions concerning determination of an effective radius for the computed pressured. They provide a mathematical analysis of this problem from a slightly different standpoint than that used elsewhere. Their approach provides further insight into the nature of the singularity, the extension to multisingularities, nonuniform grids, and the development of related approximation techniques for radially symmetric nonhomogenous problems. The authors present some fundamental new results based on the analysis.

14065 **Gravity effects in the displacement of oil by surfactant solutions.** Hornof, V.; Morrow, N.R. (Univ. of Ottawa). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 2: No. 4, 627-633(Nov 1987).

The displacement of isooctane by aqueous surfactant solutions was investigated in model porous media consisting of a thin layer of lightly sintered glass beads. Pre-equilibrated oil/surfactant pairs were prepared that exhibited interfacial tensions (IFT's) in the range of 0.06 to 2.08 mN/m [0.06 to 2.08 dynes/cm]. Because aqueous solution velocity was always higher than that of the isooctane, a stable displacement would normally be expected. While systems IFT's greater than about 1 mN/m [1 dyne/cm] showed sharp interfaces and generally stable displacements, experiments conducted at lower IFT exhibited a considerable degree of instability. In particular, at lower tensions, the interfaces became fuzzy, and there was distinct evidence of gravity underride by the aqueous phase. The onset of gravity segregation with decreasing IFT was successfully related to capillary and viscous forces operating within the systems. The degree of instability was found to increase with decreasing IFT, but oil recoveries did not necessarily decrease because of recovery mechanisms and coalescence of zones of bypassed oil.

14066 **Displacement of viscous oil from consolidated cores by caustic at temperatures above 257°F.** Mehdizadeh, A.; Handy, L.L. (California Polytechnic State Univ.). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 2: No. 4, 599-604(Nov 1987).

Laboratory data were obtained to investigate the use of alkaline material with or without a small amount of surfactant as an additive to steam to enhance oil recovery from that portion of a reservoir subjected to a hot waterflood in a conventional steamflood. A series of hot alkaline floods (some containing surfactant) was performed on fired cores previously subjected to a hot waterflood in an isothermal flooding apparatus with temperatures as high as 356°F[180°C]. Floods with no previous waterflood were also tested. In addition to temperature, salt content of the injected solution, tertiary flood rate, pH of the injected solution, oil saturation, and surfactant concentration were investigated with respect to their effects on recovery mechanism and efficiency, alkaline consumption, and surfactant loss. Results show that tertiary recovery increases with increasing temperature, increasing flood rate, increasing salt concentration in the injected caustic, and the addition of surfactant. The ultimate recoveries for the floods with no previous waterflood are comparable to those for the tertiary floods. Alkaline consumption in the presence of oil is less than that reported in the absence of oil, but still increases with increasing temperature and with decreasing flood rate. Results show that oil is recovered with the chemical additive and that no significant oil bank is formed ahead of the chemical.

14067 **Effectiveness of screening tests as predictive models for steamflood additives.** Strycker, A.R.; Madden, M.P.; Sarathi, P. (Natl. Inst. for Petroleum and Energy Research, Bartlesville, OK). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 2: No. 4, 543-548(Nov 1987).

The control of fluid mobility has become increasingly important to steamflood applications for oil recovery. Most of the EOR projects in the U.S. use steamflooding techniques. The efficiency of these projects is often reduced because such effects as gravity override result in poor volumetric sweep through the reservoir. Additives can improve the efficiency of steamflooding, but screening tests must be performed for selection of the most effective additive for individual applications. As potential additives, nine commercially available sulfonate surfactants were tested with the high-temperature/high-pressure foamability (HTHPF) test procedure, and eight of these were tested with the mobility control (MC) procedure. These surfactants were evaluated at 250 and 425°F [121 and 218°C] in deionized water and in 1% added NaCl. A correlation trend was also found between foam stability measured by the HTHPF test and mobility reduction measured by the MC test. This trend was evident for more than one type of sulfonate at both temperatures; an increase in temperature corresponded to a decrease in foam stability and mobility reduction. The dependence of foam stability on the presence of added NaCl varied from surfactant to surfactant.

14068 **Prediction of CO/sub 2/ flood performance: Interaction of phase behavior with microscopic pore structure heterogeneity.** Dai, K.K.; Orr, F.M. Jr. (New Mexico Inst. of Mining and Technology). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 2: No. 4, 531-542(Nov 1987).

This paper describes simulations of the effects of microscopic heterogeneity present in rock pore structures or resulting form high water saturations on the performance of one-dimensional (1D) CO/sub 2/ floods. In the simulations, microscopic heterogeneity was represented by dividing the nonaqueous portion of the pore space into flowing, dendritic, and trapped fractions. A 1D simulator, previously shown to model quantitatively the effects of phase behavior in slim-tube displacements, was modified to include effects of the isolated or trapped fraction unavailable for mixing with injected fluids and the dendritic fraction, which exchanges material with the flowing fraction by mass transfer. Model formulation, numerical solution, and validation tests are described. Results of simulations with no water present indicate that performance of a 1D CO/sub 2/ flood is sensitive to deviations from complete local mixing. Calculated oil recovery decreases as the flowing fraction, Peclet number, and Damkohler number decrease. Comparisons of calculated and measured residual oil saturations (ROS's) in CO/sub 2/ corefloods support this observation. Simulations of secondary and tertiary displacements by continuous CO/sub 2/ injection and alternate and simultaneous injection of CO/sub 2/ and water are compared. Performance of secondary displacements is not strongly affected by incomplete local mixing. In tertiary displacements, however, total oil recovery and the rate of recovery are reduced if effects of trapping and dendritic saturations are included.

14069 **Interpretation of miscible displacements in laboratory cores.** Bretz, R.E.; Orr, F.M. Jr. (New Mexico Inst. of Mining and Technology). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 2: No. 4, 492-500(Nov 1987).

Results of stable, first-contact miscible displacements are presented for three San Andres carbonate cores from west Texas and eastern New Mexico. All three cores showed evidence of significant heterogeneity at the core scale. Effluent composition measurements were interpreted with two relatively simple models of mixing during flow in heterogeneous porous media: the Coats-Smith (CS) mode, which represents the pore space as flowing and stagnant fractions with mass transfer between them, and a porous sphere (PS) model, which describes flow between an assemblage of porous spheres with diffusive interchange of material in the spheres with fluid flowing past them. Parameters for the two models are reported and compared. Direct measurements of some parameters from thin-sections agreed well with least-error parameters for one sample for which comparisons were possible. PS model fits showed less error than CS model fits. The form of the PS model is then used to examine how mixing effects change with changes in flow velocity, displacement length, the length scale associated with heterogeneity, and the rate of exchange of material between flowing and stagnant zones. The authors conclude that for reservoirs with scales of heterogeneity larger than those present in core samples, laboratory core displacements do not provide evidence about mixing behavior at field scale.

14070 **Effect of oil composition on minimum miscibility pressure - Part 2: Correlation.** Orr, F.M. Jr.; Silva, M.K. (Stanford Univ.). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 2: No. 4, 479-491(Nov 1987).

A new correlation for CO/sub 2/ minimum miscibility pressure (MMP) is proposed and tested. The correlation is based on experimental evidence that extraction of hydrocarbons from a crude oil depends most strongly on the size of the hydrocarbon molecules. Thus, an oil rich in hydrocarbons that are efficiently extracted should show a lower MMP than a heavier oil. The only crude-oil data needed for use of the correlation are a carbon-number distribution, which can be obtained easily by chromatography. The density of CO/sub 2/ at the MMP is correlated against a weighted-composition parameter. The MMP of any oil at a given temperature is estimated as the pressure required to yield that CO/sub 2/ density. The effects of contaminants in CO/sub 2/ can be estimated easily by calculating the pressure required to give a mixture density equal to that required for pure CO/sub 2/. Correlation accuracy was tested comparing predicted and measured MMP's for 35 oils. The proposed correlation produces MMP estimates accurate to within about 10% for most oils. Comparison of correlation predictions with those of other commonly used correlations indicates that the proposed correlation is significantly more accurate, particularly for recombined oils.

14071 **Comparison of an improved compositional micellar/polymer simulator with laboratory corefloods.** Camilleri, D.; Fil, A.; Pope, G.A.; Rouse, B.A.; Sepehrnoori, K. (Core Labs., Irving, TX). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 2: No. 4, 441-451(Nov 1987).

In this paper, the authors compare numerical simulations made with their previously reported simulator with both their own and literature experiments. The most significant improvement concerns the phase behavior model used in the simulator. The new model approximately represents the phase behavior of pseudoquaternary mixtures containing surfactant, cosurfactant, oil, and brine. The different effects of sodium and calcium cations in the mixtures are accounted for with a new cation exchange model allowing for exchange with both clays and micelles. A tertiary oilflood experiment is reported that includes a more complete analysis of phase compositions and properties than generally available previously. Produced samples were analyzed for surfactant, alcohol, sodium, calcium, polymer, tritium, water, carbon-14-tagged decane, and decane. These analyses and pressure drop were compared with simulated behavior. Supporting physical property data were used as much as possible to estimate simulator input parameters rather than adjusting or "history matching" the results. Agreement with the most important features of the experiment was good. This agreement and good agreement with an experiment from the literature lead them to conclude that a significant improvement over previous efforts has been achieved. Especially noteworthy is the capability to account for the chromatographic separation of surfactant and alcohol.

14072 **Improvements in physical-property models used in micellar/polymer flooding.** Camilleri, D.; Fil, A.; Pope, G.A.; Rouse, B.A.; Sepehrnoori, K. (Core Labs., Irving, TX). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 2: No. 4, 433-440(Nov 1987).

This is one of three companion papers describing a micellar/polymer or chemical flood simulator and comparing its results to experimental data. Various physical-property models required by chemical flood simulators have been improved and others developed. The most significant development is the use of pseudophases to model phase behavior. The method allows representation of four pseudocomponents. This is made possible by assuming that alcohol is distributed among the other three pseudocomponents, thus forming three pseudophases that are assumed to be in thermodynamic equilibrium. Another improvement related to the ion-exchange model. Cations are considered to exchange with both surfactant micelles and clays. The model assumes the exchange to be entirely a result of electrostatic association. A model for treating physical dispersion coefficients as a function of saturations has been added. The model is based on experimental evidence and is purely empirical.

14073 **Description of an improved compositional micellar/polymer simulator.** Camilleri, D.; Engelsen, S.; Lake, L.W.; Lin, E.C.; Ohno, T.; Pope, G.; Sepehrnoori, K. (Core Labs., Irving, TX). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 2: No. 4, 427-432(Nov 1987).

This is one of three companion papers describing a micellar/polymer or chemical flood simulator and comparing it to experimental data. A three-dimensional version of this simulator has been developed, but in this paper the authors describe only the one-dimensional (1D) flow equations because they focus on comparisons with linear coreflood data and related physical properties. All physical property models are the same in both versions, however. The property models described in this paper are (1) inaccessible PV, (2) permeability reduction, (3) polymer-phase viscosity, (4) adsorption, (5) residual phase saturations as a function of capillary number, and (6) relative permeabilities.

14074 **Percolation theory of steam/water relative permeability.** Parlar, M.; Yortsos, Y.C. (Univ. of Southern California). pp 379-394 of Proceedings of the 1987 SPE annual technical conference and exhibition: Reservoir engineering. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870913—).

From Annual technical conference and exhibition of the Society of Petroleum Engineers; Dallas, TX, USA (27 Sep 1987).

Technical Paper SPE 16969.

Thermal recovery and geothermal processes typically involve regimes where the simultaneous flow of water liquid and vapor takes place. In contrast to immiscible fluids, relative permeability and capillary pressure characteristics of condensing phases are not well understood at present. In this work, a systematic investigation is undertaken to derive relative permeability and capillary pressure functions for condensible phases, specifically pertaining to a steam-water system. The novel element is the use of concepts from percolation theory for the description of capillary condensation and evaporation processes in porous media obtained elsewhere. The results obtained are compared against those presently used. Implications and extensions to related processes are also discussed.

0204 Processing

REFER ALSO TO CITATION(S) 14085, 14086, 14140, 16446, 16447

14075 **(BMFT-FB-T—86-259) VCC upgrader Ruhr Oel - feasibility study. Final report.** Kleinhueckelkotten, H.; Schmedeshagen, B. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); VEBA-Oel A.G., Gelsenkirchen (Germany, F.R.)). Dec 1986. 98p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751680/JAW.

Documents were worked out within the framework of a preliminary project, which are to serve as a basis for the decision on the construction in the Ruhr District of a large-scale unit for the hydrogenation of heavy crude oil residues according to the VCC process (VEBA-Combi-Cracking). The studies included the compilation of data on the technical feasibility, the chances of obtaining official approval and the economic framework conditions. Conceptional studies with a view to determining the most favourable process and its implementation as well as the optimum site led to the following planning conception: 2-train VCC unit for 1.5 million t/a vacuum residue 510degC/sup +/ ex Venezuelan heavy crude with low-temperature carbonization of the hydrogenation residue and generation of hydrogen by steam reforming of the process gases as well as adsorption from coke oven gas at the Scholven site of the Ruhr Oel refineries. Comprehensive studies were made to arrive at the environmentally relevant data of the project. The preliminary approval was applied for and granted in the middle of 1985. Within the framework of the project study it was possible to demonstrate the technical and economic feasibility of the VCC project at the Scholven site as well as the possibility of getting it officially approved, so that positive conclusions were arrived at for all objectives pursued in the study. This decisive quantity as regards the economics of the project is, however, the price difference between light and heavy crudes, which - be it only for a transitional period - may considerably decrease due to special market developments or, in extreme cases, even lead to losses. In order to exclude this type of risks it is indispensable to agree on firm pricing and delivery terms. With 21 tabs., 12 figs..

0205 Products And By-products

REFER ALSO TO CITATION(S) 14139, 14145, 14888, 15262

0206 Health And Safety

REFER ALSO TO CITATION(S) 14111, 15694, 15695

14076 **(STF—75A87010) Alarm and shutdown frequencies in offshore production.** Bodsberg, L.; Ingstad, O.; Sten, T. (Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)). Mar 1987. 56p. NTIS (US Sales Only), PC A04. Order Number DE88751191/JAW.

This report documents an analysis of data concerning alarm and shutdown frequencies in petroleum production in the Norwegian sector of the North Sea. Almost 1300 daily activity reports submitted by oil companies to the Norwegian Petroleum Directorate (NPD) in 1984 have been reviewed. Estimates for the frequency of hazardous situations and spurious activations of components within the safety systems are presented. The overall conclusion of

this study is that the information in daily activity reports provides a good overview of trends and main problem areas on offshore production installations. However, the frequencies and figures in the report must be used with care. Personnel involved in abnormal events may not report all of these to the installation manager, and there may be several abnormal events which the oil companies, more or less unintentionally, do not report to the NPD. Additionally, free text descriptions of abnormal events are brief, causing difficulties when classifying the various events. The report is relevant to those concerned with production regularity and the safety of offshore installations. 6 refs., 11 figs., 8 tabs.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 14759, 14837

14077 (CEC—8900256) Quarterly oil report: Second quarter, 1987. (California Energy Resources Conservation and Development Commission, Sacramento (USA). Fossil Fuels Planning Office). Sep 1987. 56p. California Energy Commission Publications Unit, 1516 Ninth St., MS 13, Sacramento, CA 95814. Order Number TI88900256/JAW.

This issue covers the following: (1) petroleum fuels market activity (refinery operations, product import and export, petroleum fuels stocks, petroleum fuels supplied and petroleum fuels market shares); (2) price trends of crude oil, gasoline, diesel fuels and other fuels; (3) refinery activities; (4) petroleum production (onshore and state offshore, and Federal outer continental shelf); and (5) petroleum company financial statements. 9 figs., 9 tabs.

14078 (CMI-R—852310-4) On the economics of improved oil recovery. The optimal recovery factor from oil and gas reservoirs. Nystad, A.N. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Jun 1985. 27p. (CONF-8506293—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751194/JAW.

From 7. annual international conference of the International Association of Energy Economists; Bonn, F.R. Germany (3 Jun 1985).

We investigate an oil company's optimal depletion of oil and gas reservoirs, taking into account that the depletion policy itself influences the recoverable reserves (recovery factor) and that we have up-front capital costs. The depletion policy is defined by the amount of investment in production and in injection projects. 6 refs., 8 figs., 2 tabs.

14079 (DOE/EIA—0109(87/11)) Petroleum supply monthly, November 1987. (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Combustion and Heat Systems Div.). 25 Jan 1988. 121p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. Order Number DE88005264/JAW.

Product supplied for petroleum in the United States during November 1987 averaged 16.1 million barrels per day, reflecting a decrease of approximately 0.8 million barrels per day or 5.0% below the October 1987 level. The decrease in total product supplied occurred despite an increase in the production and imports of products of approximately 0.6 million barrels per day. November 1987 data highlights include the following: product supplied dropped approximately 0.8 million barrels per day from the October 1987 level; refinery utilization increased, reversing the downward trend started in August 1987; and Alaska set a new crude oil production record for the state.

14080 (EUR—11038) The medium- and long-term energy outlook: Energy balances in oil-importing and oil-exporting countries. Michaux, J.; Hamad, A.; Saiki, K. (eds.). (Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Organization of Arab Petroleum Exporting Countries (Kuwait). General Secretariat; Organization of the Petroleum Exporting Countries, Vienna (Austria). Secretariat). 1987. 223p. (CONF-8703233—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88920165/JAW.

From EC/OAPEC/OPEC seminar; Luxembourg, Luxembourg (17 Mar 1987).

The high level technical seminar held in Luxembourg from 17 to 19 March 1987 on the medium and long term energy outlook was jointly organized by the European Commission (EC), the Organization of Arab Petroleum Exporting Countries (OAPEC) and the Organization of the Petroleum Exporting Countries (OPEC). The objective of the Seminar was to have an informal exchange of views and information between officials and experts from the EC, OAPEC and OPEC member countries. This objective was fully achieved. One hundred participants from the staffs of the three organizing bodies, from their member states administrations, and from academic institutions had informal exchanges of views on four main subjects: medium and long term energy supply and demand outlook; energy policy responses, strategies and planning; oil market situation - impact on development and future supplies; and outlook for the refining industry and trade oil products. A final panel composed of representatives from the oil, financial and academic worlds concluded the Seminar by discussing the following theme: "Energy balances - Interdependence and international cooperation." Selected papers in this proceedings have been processed for inclusion in the Energy Data Base.

14081 (SEM—8708) Energy security issues. (Saskatchewan Dept. of Energy and Mines, Regina (Canada)). Aug 1987. 18p. (MICROLOG—87-05788). Canadian Intergovernmental Conference Secretariat, P.O. Box 488, Station A, Ottawa, Ont., Canada K1n 8V5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Light crude prices fell in November 1985. In Saskatchewan, about one third crude oil production and half the wells were threatened with the prospect of being shut-in. Combined with impacts elsewhere in Western Canada, it seemed possible that Canada would rapidly lose the ability to supply its crude oil needs and along with that much of the expertise developed by the industry in past decades. Saskatchewan's paper on energy security focuses on issues concerning the future availability of oil supply from the western sedimentary basin. In addition to reserves of light oil, Saskatchewan has a huge heavy oil base representing half of Canada's current heavy oil productive capacity. Saskatchewan has significant reserves of other energy commodities, namely uranium, coal and natural gas. A description of Saskatchewan non-oil energy reserves and their potential contribution to overall Canadian energy security is provided.

14082 Energy security. Hearing before the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, May 20, 1987. Washington, DC; Government Printing Office (1987). 198p.

William F. Martin, Deputy Secretary of DOE, was the principal witness at a hearing held to review US energy security in light of the conflict underway in the Persian Gulf and the administration's failure to provide adequate solutions to oil import dependence, which threatens national security. Committee members faulted the President's report and recommendations as an inadequate response. Martin cited progress in diversifying energy supplies away from dependence upon the Persian Gulf by increasing worldwide use of coal and non-OPEC oil use which have dropped OPEC's market share 25 points to 40%. He also noted the increase in oil imports by Europe, Japan, and Third World countries. Points at issue were the differences between spot and contract prices, which have discouraged domestic production, and the dangers associated with concentrating world production in an unstable area.

14083 Update of the status of Alaskan oil exports. Hearing before the Subcommittee on International Economic Policy and Trade of the Committee on Foreign Affairs, House of Representatives, Ninety-Ninth Congress, First Session, November 20, 1985. Washington, DC; Government Printing Office (1987). 175p.

Representatives of the Alaskan oil industry, citizen groups, and government agencies involved in trade and international affairs testified at a hearing on reauthorization of the Export Administration Act, which allowed the export of crude oil from Cook Inlet. Opponents to reauthorization cited the potential for compromising national security, the president's effort to circumvent congressional

intent, and the possibility that trade balance benefits would be illusory. Proponents argued that oil exports would relieve the trade deficit with Japan, but would also remove trade barriers with other Pacific and Asian countries. West Coast consumers argued that the availability of Alaskan oil lowers their energy and product costs. Statements and letters submitted for the record and seven appendices with additional statements and a letter follow the testimony of the seven witnesses.

0208 Waste Management

14084 **(NP—8751695) Design, construction and testing of a prototype for absorbing oil contamination in the sea. Phase 3. Construction and testing.** Daut, G.; Klein, P.; Kolberg, U.; Lorenzen, C.J.; Spandick, W.; Ulrich, W. (Krupp (Friedr.) G.m.b.H., Essen (Germany, F.R.). Forschungsinstitut). 1984. 135p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751695/JAW.

To fight the increasing contamination of the sea by oil, the Krupp Ruhr Wharf and the Krupp Research Institute developed and built an oil suction equipment for off-shore use. After manufacture of the equipment and acceptance of the electrical components, the equipment was transported to Cuxhaven for sea trials. The West German oil cleaning ship, the 'Scharhoern' was available for two days for doing the sea trials. The trials took place in a sea area north west of Heligoland. The working of the equipment was proved.

14085 **(PB—88-124540/XAB) Field assessment of air emissions and their control at a refinery land-treatment facility. Volume 1. Technical report, September 1984-May 1986.** Eklund, B.M.; Nelson, T.P.; Wetherold, R.G. (Radian Corp., Austin, TX (USA)). Oct 1987. 339p. NTIS, PC A15/MF A01.

See also Volume 2, PB—88-124557.

A field assessment was performed to measure the emissions of volatile organics from a petroleum-refinery land-treatment site. As part of the study, the emissions of total volatile organics from surface-applied and subsurface-injected oily sludge were measured over a five-week period. The effect of soil tilling on the emissions was also monitored. Volatile organics emissions rates were measured using the emission isolation flux chamber method. Emission rates of carbon dioxide and methane were also measured for use in estimating biodegradation rates. Soil samples were collected during the test periods to determine soil properties, oil levels, and microbe count. Soil surface and ambient temperatures, both inside and outside the flux chambers, were measured throughout the test periods. The measured volatile-organics emission rates were compared to applicable land-treatment models. The report is in two volumes. Volume I contains the body of the report and major appendices. Volume II contains secondary appendices, including all the raw-sample-analysis data.

14086 **(PB—88-124557/XAB) Field assessment of air emissions and their control at a refinery land-treatment facility. Volume 2. Technical report, September 1984-May 1986.** Eklund, B.M.; Nelson, T.P.; Wetherold, R.G. (Radian Corp., Austin, TX (USA)). Oct 1987. 374p. NTIS, PC A16.

See also Volume 1, PB—88-124540; Portions of this document are not fully legible.

A field assessment was performed to measure the emissions of volatile organics from a petroleum-refinery land-treatment site. As part of the study, the emissions of total volatile organics from surface-applied and subsurface-injected oily sludge were measured over a five-week period. The effect of soil tilling on the emissions was also monitored. Volatile organics emissions rates were measured using the emission isolation flux chamber method. Emission rates of carbon dioxide and methane were also measured for use in estimating biodegradation rates. Soil samples were collected during the test periods to determine soil properties, oil levels, and microbe count. Soil surface and ambient temperatures, both inside and outside the flux chambers, were measured throughout the test periods. The measured volatile-organics emission rates were compared to applicable land-treatment models. The report is in two volumes. Volume I contains the body of the report and major appendices. Volume II contains secondary appendices, including all the raw-sample-analysis data.

14087 **(PB—88-146212/XAB) Report to Congress: management of wastes from the exploration, development, and production of crude oil, natural gas, and geothermal energy.** (Versar, Inc., Springfield, VA (USA)). Dec 1987. 982p. NTIS, PC E99.

Set includes PB—88-146220 through PB—88-146253.

A separate abstract was prepared for each of the 4 parts of this collection.

14088 **(PB—88-146220/XAB) Report to Congress: management of wastes from the exploration, development, and production of crude oil, natural gas, and geothermal energy. Volume 1. Oil and gas.** (Versar, Inc., Springfield, VA (USA)). Dec 1987. 376p. NTIS, PC A17/MF A01.

See also Volume 2, PB—88-146238; Also available in set of 4 reports PC E99, PB—88-146212.

Section 3001(b) (2) (A) of the 1980 Amendments to the Resource Conservation and Recovery Act (RCRA) temporarily exempted several types of solid waste from regulation under the Federal hazardous-waste control program. This volume covers the oil and gas industry. The report was designed to respond specifically to each of the study factors that are listed in the various paragraphs of Section 8002(m) of RCRA. Each study factor is addressed in separate chapters or sections of chapters. Following the design, the volume includes: (1) a description of the oil and gas industry; (2) definition of exempt waste, including the scope of the exemption; (3) waste volume estimates for drilling fluids and produced waters; (4) characterization of waste; (5) descriptions of current and alternative waste-management practices; (6) descriptions of damage cases from oil and gas extraction; (7) a risk assessment of waste-management practices; (8) costs and economic impacts of alternative waste-management practices; (9) descriptions of current State and Federal programs applicable to oil and gas extraction; (10) conclusions and recommendations; and (11) bibliographies by chapter of references.

14089 **(PB—88-146246/XAB) Report to Congress: management of wastes from the exploration, development, and production of crude oil, natural gas, and geothermal energy. Volume 3. Appendices. A. Summary of state oil and gas regulations. B. Glossary of terms for Volume 1. C. Damage case summaries.** (Versar, Inc., Springfield, VA (USA)). Dec 1987. 362p. NTIS, PC A16/MF A01.

See also Volume 2, PB—88-146238, and PB—88-146253; Also available in set of 4 reports PC E99, PB—88-146212.

Section 3001(b)(2)(A) of the 1980 Amendments to the Resource Conservation and Recovery Act (RCRA) temporarily exempted several types of solid waste from regulation under the Federal hazardous-waste control program. These exempted wastes included drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil or natural gas or geothermal energy. Section 8002(m) of the RCRA Amendments requires EPA to study these wastes and submit a final report to Congress. The report responds to those requirements. This is volume 3 of 3 reports to Congress. The volume contains the Appendices which include a summary of: (1) State oil and gas regulatory programs; and (2) the damage cases compiled for the oil and gas industry. A glossary of oil and gas industry terms is also included in the volume.

14090 **(PB—88-146253/XAB) Report to Congress: management of wastes from the exploration, development, and production of crude oil, natural gas, and geothermal energy. Executive summaries.** (Versar, Inc., Springfield, VA (USA)). Dec 1987. 89p. NTIS, PC A05/MF A01.

See also Volume 3, PB—88-146246; Also available in set of 4 reports PC E99, PB—88-146212.

Section 8002(m) of the RCRA Amendments requires EPA to study these wastes and submit a final report to Congress. The report responds to those requirements. This document is the executive summary of the report to Congress. It includes summaries of both the oil and gas volume and the geothermal volume. Both summaries include conclusions and recommendation.

14091 **A comparison of the UCB sulfur recovery process with conventional sulfur recovery technology for treating recycle gas from a crude oil residuum hydrotreater.** Lynn, S.; Neumann, D.W.; Sciamanna, S.F.; Vorhis, F.H. New York, NY; American Institute of Chemical Engineers (1986). 29p. (CONF-860826—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Technical Paper 37F.

The University of California, Berkeley, Sulfur Recovery Process (UCBSRP) is being developed as an alternative to conventional sulfur recovery technology for removing hydrogen sulfide from gas streams and converting it to elemental sulfur. In the UCBSRP the hydrogen sulfide is absorbed by a physical solvent and the resulting solution of H/sub 2/S is mixed with a stoichiometrically equivalent amount of sulfur dioxide dissolved in the same solvent. In this paper the UCBSRP is compared to conventional technology for the case of the removal of H/sub 2/S from the recycle gas of a high-pressure petroleum residuum hydrotreater. The conventional technology selected for this comparison consists of an absorber/stripper operation using diethanol amine as the absorbent, a Claus sulfur plant, and a SCOT tail-gas treating unit. From this comparison it is estimated that the Direct Fixed Capital for the UCBSRP would be about 61% of that for the conventional technology.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 16045

14092 **(EGG—10282-2183) Biological assessment of the effects of petroleum production activities, Naval Petroleum Reserves in California, on the endangered giant kangaroo rat, Dipodomys ingens.** O'Farrell, T.P.; Kato, T.T. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Sep 1987. Contract AC08-83NV10282. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003821/JAW.

This Biological Assessment evaluates the potential adverse effects that production activities conducted on the Naval Petroleum Reserveys in California may have on the endangered giant kangaroo rat (Dipodomys ingens). DOE concluded that the direct, indirect, and cumulative effects of the proposed activities will not jeopardize the continued existence of the species because results of surveys indicated that giant kangaroo rat burrow systems and habitat was initiated; a habitat restoration program was developed and implemented; and administrative policies to reduce vehicle speeds, contain oil and waste water spills, restrict off-road vehicle travel, and to regulate public access, livestock grazing, and agricultural activities were maintained. 33 refs., 3 figs.

14093 **(EGG—10282-2187) Five-year resurvey for endangered species on Naval Petroleum Reserve No. 1 (Elk Hills), Kern County, California.** O'Farrell, T.P.; Mathews, N.E. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Sep 1987. Contract AC08-83NV10282. 129p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88003215/JAW.

A transect survey of Naval Petroleum Reserve No. 1 (NPR-1), Kern County, California, was conducted in 1984 to determine the distribution and relative abundance of endangered species and other wildlife. A total of 589.8 miles of transects were walked through approximately 47,235 acres in all or parts of 81 sections. A total of 16,401 observations of 58 species of wildlife were made which demonstrated the richness and abundance of wildlife on NPR-1 in spite of the intensity of recent petroleum developments. Although most construction activities associated with increased petroleum production took place between the first transect survey in 1979 and this resurvey, no adverse changes in relative densities of kit fox dens, prey base, or other wildlife were observed. NPR-1 should be resurveyed again in 1989. 33 refs., 5 figs., 13 tabs.

14094 **(PB—88-120837/XAB) Modeling the Alaskan Continental Shelf waters. Final report.** Liu, S.K.; Leendertse, J.J. (RAND Corp., Santa Monica, CA (USA)). Oct 1987. 151p. (R—3567-NOAA/RC). NTIS, PC A08/MF A01.

This report describes a three-dimensional ocean circulation model and two dimensional stochastic weather model used to calculate hypothetical oil-spill trajectories over the Alaskan Outer Continental Shelf (OCS) areas. Special consideration is given to the movement of sea ice in areas characterized by the presence of seasonal ice, and to ice/water interaction under different current and wind conditions. Spreading, dispersion, and weathering of crude oil, and probable landfalls of trajectories are calculated under hypothetical scenarios of oil spills from tanker accidents and well blowouts. The report also provides comparisons between simulated data on water and sea ice motion with available field observations.

14095 **(PNL-SA—14988) Laboratory setup to study two-dimensional multiphase flow in porous media.** Schiegg, H.O.; McBride, J.F. (Pacific Northwest Lab., Richland, WA (USA); Electrowatt Engineering Services Ltd., Zurich (Switzerland)). Aug 1987. Contract AC06-76RL01830. 24p. (CONF-871181—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001964/JAW.

From Petroleum hydrocarbons conference; Houston, TX, USA (17 Nov 1987).

A laboratory setup is described that minimizes sources of error. A flume was built with inside dimensions of 280 cm in length, 60 cm in height, and 15 cm in cross-sectional width. The front and back walls of the flume consisted of single glass plates to prevent preferential wetting by the oil, as would occur on acrylic plates. A uniform sand with a mean grain diameter of 0.33 mm was carefully applied in 0.15-mm layers with a funnel mounted on an automated cart. The 15-cm width was theoretically calculated to minimize the error in cross-sectional porosity caused by the larger pores next to walls. In addition, to remove the larger pores next to the walls, a fine sand was applied by the automated cart. The variation in porosity with height was smaller than 0.003. Hydrophilic and hydrophobic pressure probes were installed and connected to pressure transducers. The response time of the pressure probe apparatus was less than 0.10 seconds, and the resolution was less than 0.2-mm H_2O piezometric head. A dual-energy gamma attenuation system was used to measure fluid saturations across the width of the flume. A 1.0-Ci cesium source (0.662 MeV) and a 2000-Ci thulium source (0.084 MeV) were used to obtain 10-second counting times with a standard deviation lower than 2% fluid saturation. 18 refs., 13 figs.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 14732, 14733

14096 **Federal Onshore Oil and Gas Leasing Act of 1987. Introduced in the Senate of the United States, One Hundredth Congress, First Session, September 30, 1987.** Washington, DC; Government Printing Office (1987). 51p.

Senate consideration of S. 1730 resulted in a recommendation for passage of a bill which would open up onshore oil and gas leasing and eliminate the known geological structure (KGS) requirement for competitive bidding. The Energy and Natural Resources Committee report reviews the 1920 Mineral Leasing Act, and notes that 95% of outstanding leases were awarded on a non-competitive basis using the KGS designation. The report examines problems under the current simultaneous oil and gas (SIMO) lottery system, the probable impacts of amending the 1920 law, and analyzes each section of the proposed bill. The report concludes with correspondence, statements, and an explanation of changes which will be required in current law.

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 14130

14097 (AD-A—185759/8/XAB) Decision through optimism: the north Peruvian pipeline. Master's thesis. Zaldivar, A.G. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). May 1987. 131p. (AFIT/CI/NR—87-75T). NTIS, PC A07/MF A01.

In the early 1970's the Peruvians struck oil in their Amazon region. The state oil company, PETROPERU, and the Occidental Petroleum Company (Oxy) sought to exploit their finds in this remote area. While PETROPERU's and Oxy's areas displayed immediate promise, they both required a pipeline to transport the crude from the fields to port. Before Oxy's fields had developed to the point of needing a pipeline, PETROPERU decided to build the pipeline on their own. The most significant factors for PETROPERU's decision were: economic pressures: a suitable advanced technology that would effectively reduce exploration and exploitation costs: and a new contract philosophy that embodied the revolutionary government's approach to dealing with multinational corporations. Another factor, optimism, is more intangible, but influenced the decision strongly. This paper discusses the need for, construction of, and results of building the Northern Peru Oil Pipeline.

0230 Properties

REFER ALSO TO CITATION(S) 14070, 14111, 14144

14098 (DOE/ER/13308—T1) [Study of highly selective sorptive effects with applications to paraffins and petroporphyrin separations]: Report on research activities, January 1, 1985-December 31, 1987. (Maryland Univ., College Park (USA)). 1987. Contract FG05-85ER13308. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004528/JAW.

Monomethylalkanes and geoporphyrins were chosen for the present study as examples of separation problems that require radically different approaches to the development of multi-step isolation procedures. The following areas were studied: alkane diffusion in silicalite (a synthetic zeolite); geoporphyrins - clean-up of crude oil and shale extract; geoporphyrins - criteria for purification; and screening crude oil for geoporphyrins. Results are presented and discussed. 2 refs., 2 figs. (CBS)

14099 (NIPER—285) Understanding the chemistry relating heavy crude feedstock with product slate and quality: Topical report. Sutterfield, D.; Brinkman, D.W.; Good, W.D.; Anderson, R.P.; Wells, J.W. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Jan 1988. Contract FC22-83FE60149. 262p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88001214/JAW.

The differences in composition between conventional and heavy petroleum bring forth a group of problems affecting processing, blending, storage, and use. Typical problems include: catalyst poisoning and deactivation; high hydrogen consumption in processing; fouling of catalytic cracking units; intermediate stream instability, compatibility, and corrosiveness; higher probability of toxicity and mutagenicity of products; unpredictable product slate; inaccurate process designs; high process energy requirements; and product instability, corrosiveness, and failure to meet specifications. All of these point to the need for a better understanding of the chemistry of the heavy crudes, and an adequate data base for the design of new processes. The National Institute for Petroleum and Energy Research (NIPER) has initiated a program for developing the technology background necessary to make the transition to a heavy oil-based industry. This program is concerned with composition of heavy oils and fractions derived from them, thermodynamics of compounds occurring in or produced from heavy oil, processing, and product quality. Although each of these is addressed by projects with individual goals, they fit together and support each other in combining to form a technical foundation for heavy oil refining technology. Although the chemistry of heavy oils (the compounds and their reactions) is the unifying element, the purpose is to provide technology for the engineering developments necessary to produce our transportation fuel requirements from heavy oils. 94 refs., 59 figs., 73 tabs.

14100 (VTT-TIED—679) Characteristics and use of lubricating greases. Kytoe, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Feb 1987. 41p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751103/JAW.

The aim of this literature review of lubricating greases is to inform the consumers on the constitution and characteristics of different greases, to make selection of a suitable grease for demanding uses and comprehension of product specifications easier. A significant consitituent of lubricating greases is thicknener, which binds the lubricant and gives the grease a semi-solid state. The greases contain 3-30% of thickener, 70-95% of base oil and 0-10% of additives. Several greases of different type are used, the dominant today being the lithium greases. This dominance is based on a realatively low price and at least satisfactory properties in most of the conventional uses. The thickener of the lithium greases is lithium soap and the base oil usually mineral oil. Synthetic greases are used only for special uses. The consistency is the basic characteristic of greases. Other quantities that characterize greases are, for example, drop point, water resistance and corrosion protection characteristics.

14101 Short-chain aliphatic acid anions in deep subsurface brines: a review of their origin, occurrence, properties, and importance and new data on their distribution and geochemical implications in the Palo Duro Basin, Texas. Means, J.L.; Hubbard, N. (Battelle Columbus Labs., Columbus, OH). *Organic Geochemistry;* 11: No. 3, 177-191(1987).

Short-chain aliphatic acid anions, which are produced during the thermal maturation of sedimentary organic matter, are common in oil-field brines and other deep formation fluids. Their abundance and distribution are controlled primarily by their rates of formation, thermal and bacterial destruction, and reservoir flushing. This first part of this manuscript reviews literature on their abundance and distribution in deep basin brines, their geochemical and biogeochemical properties, and their geochemical importance, which far outweighs the number of analytical measurements that have been published. The second part reports new data from the Palo Duro Basin in the Texas Panhandle. Deep brines from the Palo Basin contain short-chain aliphatic acid anions in concentrations ranging up to 440 mg/l. The observed order of abundance is acetate >> propionate > butyrate > valerate. Aliphatic acid anion contents vary randomly with subsurface temperature, depth, and geologic age, but correlate well with ground water residence time, as inferred from $\Delta^{18}O$ measurements. Groundwaters having the longest residence times contain the highest organic acid anion contents. Organic content, I^-, and Br^- in these deep brines appear to have a common source, and all of the aliphatic acid anions, most of the I^- and some portion of the Br^- are interpreted to have been derived from lipid-rich sedimentary organic matter. This observation complicates the use of Br^- as a conservative marker constituent when inferring ground water origin and evolution using Cl^-/Br^- relationships. Also, simplified calculations indicate that these organic acid anions are not important in complexing metals. Their presence in relatively high concentrations in this basin with its low petroleum potential indicates that they cannot be used alone as petroleum proximity indicators.

0240 Storage

14102 (PB—88-125679/XAB) Benzene continuous-emission-monitoring systems for gasoline bulk storage. Bolstad, J.N. (Pacific Environmental Services, Inc., Reston, VA (USA)). Nov 1987. 65p. NTIS, PC A04/MF A01.

The report summarizes a study of continuous-emission monitors for measuring benzene emissions from gasoline bulk-storage terminals. The work was performed for the Quality Assurance Division, Source Branch, of the U.S. Environmental Protection Agency by Pacific Environmental Services under Contract No. 68-02-3997, Task 33. The Environmental Protection Agency is considering regulating the emissions of benzene from bulk storage of gasoline products and is likely to require data regarding benzene emis-

sions. The evaluation of continuous-emission monitors for benzene is a necessary part of the overall effort. The study was performed in three phases: a literature review, a laboratory evaluation, and a field evaluation. The study objectives were to determine the commercial availability of continuous monitors for benzene and the reported performance of these units, evaluate their suitability for measuring benzene in gasoline vapors, and determine their applicability to the source category.

14103 **(VTT-TIED—707) Protecting old oil tanks made of steel against internal corrosion using organic coatings.** Kaunisto, T. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1987. 41p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751089/JAW.

Water containing chlorides and sulphates can cause corrosion on the internal surfaces of buried steel tanks. After 1974 at least the bottom area os all new tanks has been painted to prevent corrosion. Older tanks are normally without any internal corrosion protection. Laboratory and field tests were carried out to investigate the applicability of glass fiber reinforced plastics and four different types of epoxy coating to the corrosion protection of the bottom area of old steel tanks. Glass fiber reinforced plastics, solventless epoxy paint and epoxy paint with normal or low content of solvent investigated showed good adhesion to steel and chemical resistance. The adherence of the resin-modified epoxy paint tested was very sensitive to the cleaning of the steel surface and its chemical resistance in petrol tanks was poor. Consequently, it is not recommended for coating petrol tanks.

03 NATURAL GAS

REFER ALSO TO CITATION(S) 14772

14104 **(PB—88-141593/XAB) Gas Research Institute 1982 appraisal results report. Final report, 1 January-31 December 1980.** (Sante Fe Corp., Alexandria, VA (USA)). 11 May 1981. 97p. NTIS, PC A05/MF A01.

See also PB—88-123120, and PB—88-141601.

The application of Project Appraisal Methodology (PAM) to GRI's 1982 R&D program is presented. PAM is an incremental benefit/cost assessment in which quantitative and qualitative measures of performance, various R&D cost scenarios, and professional judgment play integral roles to determine research and development priorities. Experience gained from application of PAM to GRI's 1981 R&D program, as well as comments from GRI's advisory bodies, the Energy Research Advisory Board, and the Federal Energy Regulatory Commission staff, provided the basis for refinement of the methodology; the refinements made, as well as the methodology's underlying assumptions, are delineated. The actual PAM framework, its application to GRI's 1982 R&D program, and the interactive appraisal process used, are described at length.

14105 **(PB—88-141601/XAB) Gas Research Institute 1983 project-appraisal-results report. Final report, 1 January-31 December 1981.** Kashyap, H. (Sante Fe Corp., Alexandria, VA (USA)). Mar 1982. 83p. NTIS, PC A05/MF A01.

See also PB—88-141593.

The process of project appraisal for budgetary allocation for the 1983 R&D program is presented. Project Appraisal Methodology (PAM), developed and refined over the past four years, is an incremental benefet/cost decision ratio incorporating quantitative and qualitative data, and professional judgment to determine relative R&D priorities. The 1983 PAM process used to determine the 1983 R&D program and help allocate the 1983 R&D funds is presented along with the PAM algorithm and methodology.

14106 **(PB—88-142096/XAB) Advisory body reports: annual meeting of Gas Research Institute (11th).** (Gas Research Inst., Chicago, IL (USA)). 2 Apr 1987. 11p. (GRI—87/0333). NTIS, PC A03/MF A01.

For the period April 1986 to March 1987, activities are reported for each of GRI's four advisory bodies: Advisory Council, Research Coordination Council (RCC), Industry Technical Advisory Committee (ITAC), and Municipal Gas System Advisory Committee (MGSAC). Evolving changes in the regulatory environment; formulation of the 1988 R&D budget and 1988-1992 plan; support of gas-related geosciences research; technical aspects and the relevance of current issues such as low oil prices, the gas deliverability surplus, fuel-switching capabilities, and the dynamics of gas pricing; special problems and R&D needs of the gas industry; indoor air quality, compressor station operation and maintenance, gas cooling systems, gas appliances, and secondary-gas-recovery technologies were topics discussed.

0301 Reserves

REFER ALSO TO CITATION(S) 14115

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 14039, 14046

14107 **(PB—88-142120/XAB) Borehole flowmeter. Annual report, February 1984-May 1985.** DiBello, E.G.; McWilliams, J.L. (BDM Corp., Albuquerque, NM (USA)). Jun 1985. 82p. (BDM/A—85-0619-TR). NTIS, PC A05/MF A01.

See also PB—88-130273.

A prototype borehole flowmeter was developed for the purpose of characterizing gas-flow distributions within Devonian Shale gas wells. Current technology for locating and measuring the gas-producing zones in the Devonian Shale well environment is indirect and inadequate due to the low flow rates involved. The ultrasonic flowmeter uses the time-of-flight approach to measure gas flow. Features incorporated in the borehole system include: (1) ultrasonic flowmeter; (2) temperature and pressure sensors; and, (3) gamma-ray counter and (4) X-Y volumetric caliper. Bench testing of sonic transmitter/receiver components has verified the feasibility of the design approach. A prototype system was fabricated and calibrated for use in the 0 to 50 cubic feet per minute range of gas flow. The prototype was tested in four Devonian Shale wells.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 14045, 14051, 14064, 14078, 15569

14108 **(CMI-R—862321-2) Worth of marginal gas reserves.** Stensland, G.; Haaberg, T. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Feb 1986. 32p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751212/JAW.

Two different development alternatives are evaluated for a hypothetical oil and gas field. Because of the properties of the structure, the oil has to be produced first and the gas afterwards. The problem is then to decide between the two alternatives: to build combined oil and gas platform, or to build a simple oil platform and later possibly a gas platform. The future price of gas is uncertain. refs., 8 tabs.

14109 **Case study of gas migration in the Wasatch and Mesaverde formations of the Piceance Basin, Colorado.** Mercer, J.C.; Ammer, J.R.; Frohne, K.H. (U.S. DOE, Morgantown Energy Technology Center). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 2: No. 4, 677-682(Nov 1987).

The U.S. DOE Morgantown Energy Technology Center (METC) conducted a reservoir simulation study and an engineering analysis on gas migration for two tight lenticular sandstone units, the Wasatch formation and the Mesaverde group, in Garfield County, CO. The study quantified potential gas loss through migration from the Naval Oil Shale Resere (NOSR) No. 3 to nearby producing wells located in the Rulison field and forecasted production for proposed NOSR No. 3 offset wells located at previously selected sites, offsetting commercial wells outside the reserve. After the reservoirs where characterized, production was forecasted by use of a reservoir simulator to history match actual production. A dual-porosity reservoir simulator, developed specifically for naturally

fractured gas-producing reservoirs, and reservoir engineering calculations were used in the study. The study followed two extensive DOE field testing programs, a nearby multiwell experiment (MWX), and a special Mesaverde test well (1XM9) drilled in NOSR No. 3. These DOE field tests provided geologic information and values for reservoir parameters that control production from this unconventional gas resource. In addition to the results from the two field experiments, the study used a detailed geologic analysis and production data from nearby industry wells to characterize the producing formations.

0304 Products And By-products

REFER ALSO TO CITATION(S) 14816

14110 (SRI—2352) An Assessment of the catalytic conversion of natural gas to liquids. Final report. Field, S.; Nirula, S.C.; McCarty, J.G. (SRI International, Menlo Park, CA (USA)). Jun 1987. 109p. (MICROLOG—87-05822). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This study compares the conceptual process economics of the direct conversion of methane to olefins followed by olefin oligomerization to gasoline (the ARCO route) with the commercially proven route that converts methane to methanol, which is subsequently processed to gasoline (the Mobil route). In addition, the process economics of transforming methane into mixed alcohols, valuable as blending stocks for unleaded gasoline are examined. Those and other generalized processing sequences are summarized. 20 figs., 40 tabs.

0305 Health And Safety

REFER ALSO TO CITATION(S) 14076, 15694

14111 (CMI-R—865403-8) Numerical simulation of gas explosions in two-dimensional geometries. Bakke, J.R. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Nov 1986. 111p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751115/JAW.

This report is a corrected version of the author's dr.scient. (Ph.D) thesis. It describes the theory, modelling and numerical solution procedure behind the code FLACS-ICE-2D. Comparison with extensive experimental data has been performed to validate the code. The objective of the work is to produce a tool for calculating overpressures from accidental gas explosions in offshore installations. The results presented show that the effect of variations within a set of parameters on maximum explosion overpressures are accounted for by the code. The geometries studied are the tube and the radial vessel. These are idealized geometries. However, the parameter variations that have been studied are typical of the kind of extensions one would make to change over to realistic (offshore module) geometries. Some calculations in an idealized compressor module are also presented. These are compared with three-dimensional calculations in the same geometry, and the results are encouraging. 69 refs., 44 figs., 5 tabs.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 14078, 14759

14112 (DOE/EIA—0130(87/09)) Natural gas monthly, September 1987. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 25 Nov 1987. 147p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88003328/JAW.

This document highlights activities, events, and analyses of interest to public and private sector organizations associated with the natural gas industry. Volume and price data are presented each month for natural gas production, distribution, consumption, and interstate pipeline activities. Producer related activities and underground storage data are also reported. 6 figs., 32 tabs.

14113 (DOE/EIA—0130(87/10)) Natural gas monthly, October 1987. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 11 Jan 1988. 202p. NTIS, PC A10/MF A01 - GPO; 1; GPO Dep. Order Number DE88005029/JAW.

This document highlights activities, events, and analyses of interest to public and private sector organizations associated with the natural gas industry. Volume and price data are presented each month for natural gas production, distribution, consumption, and interstate pipeline activities. Producer related activities and underground storage data are also reported. From time to time, the NGM features articles designed to assist readers in using and interpreting the natural gas information. 9 figs., 34 tabs.

14114 (DOE/EIA—0131(86)/2) Natural gas annual, 1986: Volume 2. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 11 Jan 1988. 145p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88005020/JAW.

This document provides information on the supply and disposition of natural gas to a wide audience including industry, consumers, federal and state agencies, and educational institutions. This report, Volume 2, presents summary data by Census Division and by state for 1982 through 1986.

14115 (DOE/EIA—0506) Gas deliverability and flow capacity of surveillance fields in Louisiana. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Nov 1987. 55p. NTIS, PC A04/MF A01 - GPO; 1; GPO Dep. Order Number DE88003843/JAW.

This study deals with Louisiana fields producing gas-well gas (nonassociated and/or associated), excluding the Federal Offshore Areas. Of the 260 fields studied, 39 are in North Louisiana, 194 are in South Louisiana, and 27 are in the State Offshore Area. Gas-well gas volumes used in this study were reported as volumes of gas less shrinkage due to the extraction of lease condensate but not plant liquids. During 1986, gas-well gas production from these large fields amounted to 1018 billion cubic feet (Bcf). This is 55% of the 1860 billion cubic feet of gas produced from Louisiana in 1986. Gas-well gas production from surveillance fields was 46% of the total gas from North Louisiana, 59% from South Louisiana, and 46% from Louisiana State Offshore. In 1987, the flow capacity of the surveillance fields was calculated to be 1456 billion cubic feet per year in Louisiana. By the year 2006, the flow capacity of these large fields was calculated to decrease to 94 billion cubic feet per year. If additional flow capacity is added by completions in new reservoirs, the decrease in flow capacity will be slower. As a group, the 260 surveillance fields in Louisiana could produce at the 1986 rate until 1990, provided the deficiency in annual deliverability of some fields is made up by production from the excess flow capacity of others. This simply means that fields that could not produce at their 1986 rate, even as early as 1987, could have their production deficit made up from other fields with excess flow capacity. 12 refs., 23 figs., 7 tabs.

14116 (PB—88-141544/XAB) Impact of cogeneration on gas use in the industrial and electric-utility sectors. Summary. (Gas Research Inst., Chicago, IL (USA)). 1987. 10p. (GRI—86/0112.1). NTIS, PC A02/MF A01.

See also report dated Jan 1986, PB—86-203270.

This summary reviews a study, Impact of Cogeneration on Gas Use in the Industrial and Electric Utility Sectors, as evaluated under a scenario favorable to cogeneration. The major impacts examined include the level of electric cogeneration, fuel use, and fuel mix in the industrial sector; the regional variations in fuel use; and the level of electric generation, fuel use, and fuel mix in the electric-utility sector.

14117 (PB—88-141569/XAB) Gas Research Institute 1986 annual report. Enhancing natural-gas value: wellhead to burner tip. (Gas Research Inst., Chicago, IL (USA)). 1987. 57p. (GRI—87/0332). NTIS, PC A04/MF A01.

Color illustrations reproduced in black and white.

GRI's 1986 Annual Report presents financial information and briefly describes 19 of more than 35 GRI technologies that

have entered commercial use. It also provides information on new technologies to enhance the value of natural gas to end-users such as reducing the cost of finding and producing natural gas from underutilized sources like formations, coal seams, and watered out reservoirs; helping the pipeline and distribution companies reduce the cost of transporting, storing, and delivering natural gas to the end-user; improving the performance of gas end-use equipment; and introducing new equipment that provides least-cost energy. Also listed are members of the GRI Board of Directors, advisory bodies, and management; member companies; and 1986 R&D contractors.

14118 **(PB—88-142112/XAB) Market opportunities for gas-fired cogeneration in US industrial applications. Topical report.** Williams, J.H.; Streicher, A. (Hagler, Bailly and Co., Washington, DC (USA)). Jul 1983. 129p. (PA—83-0376). NTIS, PC A07/MF A01.

Existing studies addressing U.S. industrial cogeneration markets were reviewed. Fewer than 10 specifically addressed industrial markets for gas-fired cogeneration systems and contained projections for market potential at a level of detail sufficient to support GRI's program. For perspective on opportunities for these systems over 500 specific industrial processes were analyzed. The discussion is divided into four parts. In Chapter 1, market opportunities for process steam/electric fired cogeneration systems are discussed. In Chapter 2, industrial processes where direct heat/electrical gas-fired cogeneration is technically possible are identified. In Chapter 3, process steam/mechanical drive gas-fired cogeneration industrial processes are identified. In Chapter 4, industrial processes are identified where direct heat/mechanical drive cogeneration opportunities exist. Maximum potential market for gas-fired cogeneration technologies could exceed 75,000 MWe in existing industrial plants. Of the maximum potential, 60% occurs using process energy in the form of steam and 40% in the form of direct heat.

14119 **(PB—88-142179/XAB) Natural gas supply initiatives: new methods for enhanced production.** (Gas Research Inst., Chicago, IL (USA)). 1987. 12p. (GRI—87/0329). NTIS, PC A03/MF A01.

Projections of low oil prices through the early 1990's demand a reshaping of exploration strategies to reflect changing market conditions. GRI has initiated new thrusts in secondary gas-recovery research with the aim of achieving low-marginal-cost recovery of gas-in-place from existing wells that were overlooked or abandoned after the primary production phase, and re-exploration of known gas fields to find previously unidentified gas-bearing formations. The report briefly describes technologies GRI is currently investigating to increase near-term supply: geologically-based infill drilling strategies; cased-hole logging; co-production of gas and water; seismic-borehole tomography; borehole fracture mapping; real time monitoring, analysis, and control; integrated log analysis and enhanced stress profile; and directional drilling.

14120 **(PB—88-145354/XAB) Long-term trends in US gas supply and prices: the 1986 GRI (Gas Research Institute) baseline projection of US energy supply and demand to 2010.** Woods, T.J. (Gas Research Inst., Chicago, IL (USA)). Apr 1987. 58p. (GRI—87/0334). NTIS, PC A04/MF A01.

This report summarizes the gas supply outlook in the 1986 GRI Baseline Projection of U.S. energy supply and demand through 2010, which has been adopted for GRI's 1986-87 planning cycle. The projection shows U.S. gas consumption remaining near current levels of slightly less than 18 quads through the end of the 1980s. Gas availability at competitive prices may enable consumption of 19 quads or more in the 1990s primarily due to increased gas consumption in the commercial and electric-utility sectors. A stable level of gas production of about 17 quads is expected through 2000 due to contributions of advanced technology to Lower-48 production; after 2000, a decline is anticipated to 15.2 quads in 2010.

14121 **(WG—8707) Manitoba Consumer Gas Corp.: estimate of value of the shares of Greater Winnipeg Gas Company and ICG Utilities (Manitoba) Ltd.** (Wood Gundy, Inc., Toronto, Ontario (Canada)). Jul 1987. 78p. (MICROLOG—87-05986). Manitoba Dept. of Energy and Mines, Legislative Bldg., Rm. 301, Winnipeg, Man., Canada R3C 0V8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The purpose was to estimate a fair marker value for the shares of Greater Winnipeg Gas Company and ICG Utilities (Manitoba) Ltd. (collectively Manitoba Consumers Gas Corp). Certain valuation techniques commonly employed in the investment industry were used to determine the value of the shares of gas and other utility companies. Based on according the greatest weight to the multiple of net book value and dividend yield approaches, and very little weight to the other approaches, the value of the shares of Manitoba Consumers Gas Corp. were estimated between $87 million and $93 million. Based on a share value of $87 million to $93 million, the gross value of the distribution assets of Manitoba Consumers Gas Corp. could be in a range of $177 million to $183 million as determined by adding back the book value of the long term and short term debt as at December 31, 1986. 28 tabs.

14122 **Drawing the line on natural gas regulation: The Harvard study on the future of natural gas.** Kalt, J.P.; Schuller, F.C. (eds.). New York, NY; Quorum Books (1987). 124p. (DOE/PE/78001—T1). Energy & Env. Policy Ctr., Harvard Univ., 79 JFK St., Cambridge, MA 02138. Order Number TI88004226/JAW. Contract FG01-86PE78001.

The Harvard Study on the Future of Natural Gas Policy reflects the ideas, discussions, and debates of nine authors and more than seventy experts from business, government, and academia. These study participants constituted the Executive Working Group, which met in three sessions during 1984-1985. The executive sessions provided forums for the authors to present versions of their chapters at progressive stages of development. The results were invaluable insights and perspectives from parties directly involved in the ongoing debates over the reform of natural gas policy. In addition, a number of participants have contributed written comments on the various chapters of this book.

0307 Waste Management

REFER ALSO TO CITATION(S) 14087, 14088, 14089, 14090

0308 Environmental Aspects

14123 **(CONF-8709202—1) Successful revegetation of a gas pipeline right-of-way in a Gulf Coast barrier island ecosystem.** Hinchman, R.R.; George, J.F.; Gaynor, A.J. (Argonne National Lab., IL (USA); Gas Research Inst., Chicago, IL (USA); El Paso Natural Gas Co., TX (USA)). 1987. Contract W-31109-ENG-38. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002950/JAW.

From 4. water quality and wetlands management conference; New Orleans, LA, USA (24 Sep 1987).

This study evaluates the revegetation of a 30-m-wide right-of-way (ROW) following construction of a 76-cm-diameter natural gas pipeline across Padre Island, Texas, a Gulf Coast barrier island. ROW construction activities were completed in 1979 and included breaching of the foredunes, grading, trenching, pipeline installation, and leveling - which effectively removed all existing vegetation from the full length of the ROW. Following construction, the foredunes were rebuilt, fertilized, and sprigged with Panicum amarum, a native dune grass known as bitter panicum. The remainder of the ROW across the mid-island flats was allowed to revegetate naturally. Plant cover by species and total vegetative cover was measured on paired permanent transects on the ROW and in the adjacent undisturbed vegetation. These cover data show that the disturbed ROW underwent rapid vegetative recovery during the first two growing seasons, attaining 54% of the cover on the undisturbed controls. By 1984, the percent vegetative cover and plant species

diversity on the ROW and the adjacent undisturbed control area were not significantly different and the ROW vegetation was visually indistinguishable from the surrounding plant communities. 9 refs., 3 figs., 2 tabs.

14124 **Dispersion phenomenology of LNG vapor in the Burro and Coyote LNG spill experiments.** Morgan D.L. Jr. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *Journal of Heat Transfer;* **109**: No. 4, 952-960(Nov 1987). Contract W-7405-ENG-48.

Various physical phenomena affecting LNG vapor dispersion were observed in LNG spill experiments conducted by the Lawrence Livermore National Laboratory. Unterstanding the phenomena is necessary in predicting the size of the hazardous region of vapor concentration following a spill. Gravity flow of the cold dense vapor increased cloud width while density stratification and heat flow from the ground had substantial effects on the mixing rate with air. Density stratification inhibits turbulent mixing while heat flow into the cloud promotes it through a number of processes including buoyancy. Some possible instances of buoyancy were observed in the experiments, and calculations indicate that modest amount of additional heat might substantially increase cloud dispersion. In the experiments, these phenomena led to a dependence of the maximum distance L-script to the lower flammability limit on source rate, wind speed, and atmospheric stability that was substantially different from the prediction of the Gaussian plume model. Including these phenomena in predictive models is important for their model. Time-dependent features of the concentration field due to turbulence and rapid phase-transition explosions, which also affect L-script, were examined by applying a space—time interpolation scheme to the concentration data.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 14119

14125 **(DOE/METC—88/4075) Gas hydrate model development and validation.** Burshears, M.; Dominic, K. (USDOE Morgantown Energy Technology Center, WV). Aug 1987. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001004/JAW.

A two-phase, three-dimensional numerical model was developed to simulate the dissociation and formation of hydrates (composed of water and any stable mixture of methane, ethane, or propane) when a conventional gas reservoir is in contact with hydrates. This model was developed in order to address fundamental questions on the feasibility of dissociating hydrates using the depressurization that accompanies production of a conventional gas reservoir. The major implications of the simulation are quite favorable, suggesting that massive hydrate can be dissociated at appreciable rates without an external source of heat energy. These results support the continued evaluation of gas hydrates as a potential resource and indicate a need for model validation. Because of scant documentation on the production of gas from hydrates in the literature, this simulator could not be validated using conventional methods. An alternative means of testing was required. A three part procedure, based on the availability of data, was devised to test different components of the simulator. The testing consisted of a qualitative examination of the total system and a quantitative testing of the two portions of the model (i.e., the production of a conventional gas reservoir and the dissociation of massive hydrate). Existing resources were used in the first two parts of this testing. An examination of the dissociation of massive hydrate was the third step toward model validation. Based on the encouraging findings of the first two parts of testing, a laboratory simulation of the behavior of a gas hydrate reservoir during preasure reduction was undertaken. In the DOE/METC Gas Hydrates Laboratory, an experiment was designed to produce gas from depressurization and dissociation of synthesized methane hydrate. The flow rate was allowed to vary. The data from this experiment have been used to test and refine the simulator. 5 refs., 7 figs.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 14096, 14732, 14733

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 14123, 14133

14126 **(PB—88-141577/XAB) Theory for accelerated slow crack propagation in polyethylene fuel pipes. Final report, April 1984-March 1987.** Moet, A.; Chudnovsky, A. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Macromolecular Science). Aug 1987. 55p. NTIS, PC A04/MF A01.

See also Annual Report for 1984-87, PB—86-136454.

A test procedure was designed which makes possible the observation of the entire crack-propagation history of 2306-IIC MDPE fuel gas pipe within about five days. The test specimen is an arc cut from the pipe and exposed to fatigue loading. Fractographic analysis reveals that the crack propagates by a dominantly brittle mechanism which becomes progressively more ductile until ultimate failure by tearing. Employing the crack layer theory, the specific enthalpy of brittle fracture was found to be about 800KJ/cu m. This quantity is a candidate parameter for characterizing the material's resistance to brittle crack propagation.

14127 **(PB—88-141627/XAB) State-of-the-art interior gas-piping systems. Part 1. Topical report, December 1983-December 1986.** Belkus, P.; Valentine, J.; Torbin, R.N. (Foster-Miller, Inc., Waltham, MA (USA)). Apr 1987. 169p. NTIS, PC A08/MF A01.

See also Part 2, PB—88-141635.

Interior gas-piping technology varies around the world. To assess the different approaches, a state-of-the-art review was conducted on the technology being used in the United States, Japan, and Europe. The results of the survey indicate that the most commonly used system consists of rigid steel pipe, with threaded joints operated at low pressure (6 in. W.C.). There are, however, other more-innovative interior gas-piping practices being implemented.

14128 **(PB—88-141635/XAB) State-of-the-art interior gas-piping systems. Part 2. Compendium. Topical report, December 1983-December 1986.** Belkus, P.; Valentine, J.; Torbin, R.N. (Foster-Miller, Inc., Waltham, MA (USA)). Jan 1987. 121p. NTIS, PC A06/MF A01.

See also Part 1, PB—88-141627.

This compendium on the State-of-the-Art Interior Gas Piping Systems is one part of a two-part report and stresses the hardware aspects of the state-of-the-art of the technology being used in the U.S., Japan, and Europe. The other report is a more general discussion of the same subject with emphasis on the installation of the gas-piping system. The compendium includes sections on piping, joints and connectors, accessories, and hardware/system information. The sections contain information and catalogs from equipment manufacturers who supply hardware for interior gas-piping systems.

14129 **(PB—88-142088/XAB) Horizontal boring technology, winter 1986/1987.** (Gas Research Inst., Chicago, IL (USA)). 1987. 11p. (GRI—87/0330). NTIS, PC A03/MF A01.

Color illustrations reproduced in black and white.

By 1988, two new guided horizontal boring systems developed by GRI are expected to become commercially available to the gas industry. Development of the guided piercing tools and extended-range horizontal boring systems addresses the industry's requirements for short range (up to 120 feet) and longer range (up to 200 to 2000 feet) horizontal boreholes. Based on preliminary economic analysis, the short-range tool can reduce installation and restoration costs of underground natural gas distribution piping by 15 to 50%, compared to conventional trenching, backfilling, and restoration costs.

14130 (STF—60A86114) Protection of pipelines in the surf zone by means of blasted trenches. Kristiansen, Oe.; Sveggen, O. (Norsk Hydroteknisk Lab., Trondheim). Aug 1986. 114p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751196/JAW.

This report discusses certain problems related to the shore approach of pipelines and focuses particularly on blasted trenches with associated backfilling material as a method of protecting the pipeline against current and waves. To improve and optimize the design method for the backfilling material, regarding both amount and size of the individual stones, experimental tests have been performed. To ensure a satisfactory overall protective structure, filter criteria acceptance has been integrated in the new proposed design method. 8 refs., 46 figs., 18 tabs.

0330 Properties

REFER ALSO TO CITATION(S) 14111, 14125

14131 (PB—88-141619/XAB) Analysis of gases in the earth's crust. Annual report, March 1986-February 1987. Jenden, P.D. (Global Geochemistry Corp., Canoga Park, CA (USA)). May 1987. 142p. NTIS, PC A07/MF A01.

See also report dated May 1986, PB—87-116257.

During the current reporting period, 131 natural gas samples were collected for chemical analysis and stable isotopic measurements of carbon, hydrogen, nitrogen, sulfur and helium. Studies of these and earlier samples have improved geochemical models for hydrocarbon exploration by: (1) augmenting the understanding of the origin and distribution of microbial gases; (2) introducing more-effective ways of recognizing mixing between microbial and thermogenic gases; and, (3) documenting a novel instance of reservoir alteration by bacteria. Based on the characteristics commonly attributed to deep-earth gas, the authors conclude that deep-earth hydrocarbons are a minor component in most oil and gas reservoirs. Deep-earth carbon dioxide and nitrogen could be volumetrically more significant. These conclusions are currently being tested in the supergiant Hugoton-Panhandle gas production area of the U.S. Mid-continent.

14132 (PB—88-142153/XAB) Methane activation by metals and semiconductors: molecular orbital theory. Annual report, September 1986-August 1987. Anderson, A.B. (Case Western Reserve Univ., Cleveland, OH (USA)). Sep 1987. 126p. NTIS, PC A07/MF A01.

A predictive molecular-orbital theoretical study of CH_4 activation on coordinatively unsaturated transition-metal centers shows high activity for the metal surfaces studied, (100) and (110) and rough (100) Fe, (100) and (111) Ni, and (111) Pt; the more-open surfaces are more reactive because the surface atoms have fewer coordination neighbors. This allows a surface atom greater flexibility for stabilizing C...H...M and C...M bonding orbitals as the metal atom inserts into the CH bond. A 4-coordinate Mo IV cation on the edge of a MoS_2 crystal is predicted to easily activate CH_4 by inserting into a CH bond. Initial products are oxidative homolytic but H will shift to S(2-), resulting in heterolytic products. CH_3 bound to Mo can dehydrogenate to yield doubly bound CH_2 but further dehydrogenations are not energetically favorable. These findings indicate it may be possible to incorporate CH_4 in Fischer-Tropsch catalysis over MoS_2. A review of theoretical work on structure and electronic factors in heterogeneous catalysis dealing in C=C, C=O, and CH activation by metals and oxides was prepared. The importance of 0^- to CH_4 activation is explained.

14133 (RF/PRC/T—3/86) Vibrating element transducers for on-line measurement of natural gas density. Norvik, H. (Rogalandsforskning, Stavauger (Norway)). Feb 1987. 86p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751206/JAW.

The gas velocity-of-sound effect on vibrating element density transducers is investigated. A correction formula for cylindrical membrane transducers is rigorously derived from basic principles. A large set of experimental data (including some not previously published) is analyzed and used for verification of theory. The 7810 and 7811 transducers from the British manufacturer Solartron are dea with specifically, but the results are quite general. 13 refs., 31 figs., 10 tabs.

0340 Combustion

REFER ALSO TO CITATION(S) 14459

14134 (GRI—87/0106) Competitive position of natural gas: Central thermal fluid systems (CTFS) for plastics curing and forming: Topical report, May 1986-October 1987. Williams, S.; Koch, G.S. (Hagler, Bailly and Co., Washington, DC (USA)). Oct 1987. 121p. Gas Research Institute, 8600 W. Bryn Mawr Ave., Chicago, IL 60631. Order Number TI88900315/JAW.

This study provides insights into the relative costs and technical capabilities of various plastics platen heating technologies. The report focuses on the competitiveness of the gas-based technology and the variables between systems that might affect choice of a system for a particular application. It relates these factors to potential requirements for advanced gas systems that would enhance the viability of this technology in a market historically dominated by electric equipment. Specific data and results presented in the report are useful to R and D managers, technology developers, and gas utility service representatives and planners. 47 refs., 9 figs., 20 tabs.

14135 (GRI—87/0107) Competitive position of natural gas: Ovens for curing and heating plastics film and sheet: Topical report. Williams, S.; Koch, G.S. (Hagler, Bailly and Co., Washington, DC (USA)). Oct 1987. 59p. Hagler, Bailly & Company, 2301 M Street, N.W., Washington, DC 20037. Order Number TI88900345/JAW.

This study provides insights into the relative costs and technical capabilities of various curing and heating technologies for plastic film and sheet. The report focuses on the competitiveness of gas-based technologies and the variables between systems that might affect choice of a system for a particular application. It relates these factors to potential requirements for advanced gas systems that would enhance the viability of gas ovens in a market dominated by electric equipment. Specific data and results presented in the report are useful to R & D managers, technology developers, and gas utility service representatives and planners. 51 refs., 10 figs., 13 tabs.

14136 (PB—88-142146/XAB) Evaluation of a dual-chamber kerosene-heater combustion technology. Topical report, June-December 1985. Kardas, A. (Institute of Gas Technology, Chicago, IL (USA)). Oct 1987. 36p. NTIS, PC A03/MF A01.

A kerosene heater equipped with a dual-chamber combustor was procured, tested, and technically evaluated to determine its applicability to natural gas combustion. The kerosene heater was found to have nitric oxide (NO), nitrogen dioxide (NO_2), and carbon monoxide (CO) emissions of 0.0)2, 0.006 and 0.02 lb/10^6 Btu input, respectively, much lower than those of blue-flame natural-gas combustors. A basic study was conducted to understand the interaction between kerosene combustion and the surrounding metal sleeves forming the dual chamber. Combustion characteristics of kerosene and natural gas were compared to formulate potential designs of low-emitting natural gas combustors. Three concepts were developed for low-emitting burners: an atmospheric burner to replace the kerosene wick in the dual chamber; the same concept with a powered vent; and a two-stage system equipped with a powered vent.

0350 Storage

14137 (BMFT-FB-T—86-253) Survey tool for gas cavities. Final report. Nolte, E. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Prakla-Seismos G.m.b.H., Hannover (Germany, F.R.)). Dec 1986. 63p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751677/JAW.

Survey methods were developed for the surveillance of the change of shape and volume in compressed-air and gas-storage cav-

ities during operation. The work carried out included the development of an infra-red pulse laser for range finding and the further development of sonic survey techniques previously applied only in fluid-filled cavities. A modified stereo-photo tool was tested, too. The initial aim to survey gas-filled cavities exclusively by the laser technique was not achieved owing to high absorption as a result of the cavity medium. On the other hand, with the present experience, it was possible to survey operating compressed-air as well as other air-filled cavities without difficulty. Ultra sonic surveys are suitable for gas-storage cavities with internal pressures of 70 bar. With 19 refs., 16 figs..

04 OIL SHALES AND TAR SANDS

0402 Site Geology And Hydrology

REFER ALSO TO CITATION(S) 14141

14138 Rates of relative plate motion during the Acadian orogeny based on the spatial distribution of black shales. Ettensohn, F.R. (Univ. of Kentucky, Lexington). *Journal of Geology;* **95**: No. 4, 572-582(Jul 1987). Contract AC21-76ET12040.

Devonian-Mississippian black shales apparently were deposited in foreland basins formed in response to deformational loading in the Acadian orogen. These black shales were deposited in a succession of partially overlapping basins separated from each other by coarser clastic units, which migrated episodically southwestward in time parallel to the orogen. If foreland basins are results of an isostatic response to deformational loading in the orogen, migration of successive basins along the orogen must reflect concomitant shift of orogeny, and hence relative plate motion in the same direction. These black-shale deposits, then, not only demonstrate the diachronous nature of the Acadian orogeny, a fact previously indicated by other lines of evidence, but also enable approximation of rates of relative plate motion to be made. Using three different dating schemes, the black-shale deposits indicate Late Devonian plate motion along an 800 km segment of the orogen during approximately 11 Ma, for an average rate of relative plate motion slightly greater than 7 cm/yr. The facts that the black-shale basins do apparently track plate movement and resulting orogeny and that the along-strike component of basin migration exceeds the perpendicular-to-strike component suggest that at least Late Devonian parts of the Acadian orogeny are related to episodes of oblique convergence involving major strike-slip movement with substantial amounts of transpression. 72 references.

0404 Oil Production, Recovery, And Refining

14139 (EMR/ERL—84-63-J) Kinetic studies of coke formation in hydrocarbon fractions of heavy crudes. Banerjee, D.K.; Laidler, K.J.; Nandi, B.N.; Patmore, D.J. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Energy Research Labs.). Oct 1984. 25p. (MICROLOG—85-5969). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Different types of bitumens were separated into fractions classified as asphaltene, soft resin, hard resin, aromatics and saturates. The various fractions were then kept at temperatures ranging from 395/sup 0/C to 510/sup 0/C, and measurements made of the amounts of coke produced as a function of time. The results were analyzed to give rate constants and activation energies for coke (toluene insoluble) formation. The rate of coke produced as a function of time was determined. The results were analyzed to give rate constants and activation energies for coke (toluene insoluble) formation. It was found that the rate of coke formation is greater the higher the degree of aromaticity of the feed stock. The results have led to a tentative mechanism for the formation of coke, by a rapid reaction from large aromatics formed as intermediates. 9 figs., 4 tabs.

14140 (OU/C—8610) Kinetic studies of coke formation in hydrocarbon fractions of different bitumens under various conditions. Phase 3. Final report. Laidler, K.J.; Banerjee, D.K. (Ottawa Univ., Ontario (Canada). Dept. of Chemistry). Oct 1986. 60p. (MICROLOG—87-05819). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Kinetic studies were made of coke formation from hydrocarbon fractions of bitumens and heavy oil. The experimental program was divided into: separation of four feedstocks into asphaltene, soft resin, hard resin, saturates and aromatics, and study of the kinetics of coke formation from the feedstocks themselves and from the corresponding asphaltenes and soft resins in a atmosphere of hydrogen. Each fraction from four heavy crudes was separated into asphaltene, soft resin, hard resin, aromatics and saturates. Elemental analyses were carried out on the fractions. For three of the crudes and their fractions, rate measurements were made of coke formation in atmosphere of hydrogen at a pressure of 15 MPa (2250 psi), and at different temperatures. The rates of coke formation were significantly higher for the asphaltenes than for the resins. Little coke was obtained from the aromatics and saturates. There is some correlation between aromaticity and rate of coke formation, but structural effects also play a role. The rates of coke formation from the heavy crudes are correlated with the percentages of asphaltene and resins present in them. Athabasca crude and its fractions show significantly different behaviour from that shown by the pipeline crudes and their fractions.

14141 Laboratory measurements relevant to two-phase flow in a tight gas sand matrix. Chowdiah, P. (Institute of Gas Technology). pp 125-136 of Proceedings of the 1987 SPE annual technical conference and exhibition: Reservoir engineering. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870913—).

From Annual technical conference and exhibition of the Society of Petroleum Engineers; Dallas, TX, USA (27 Sep 1987).

Technical Paper SPE 16945.

True drainage measurements of specific water permeability, gas entry pressure, critical gas saturation and effective gas permeability at in-situ stress conditions have been conducted on several tight sandstones, mostly from the Mesaverde formation. The results have been used to develop some general rules useful in making meaningful estimates of both drainage and inhibition relative permeability curves for use in reservoir simulation.

14142 Laboratory studies of forward combustion in the tar sand triangle resource. Romanowski, L.J. Jr.; Thomas, K.P. (Western Research Institute, Laramie, WY 82071). *In Situ;* **11**: No. 2, 191-210(1987).

The in situ forward combustion process in a Utah tar sand was evaluated at alternative operating conditions. Five bench-scale tube reactor experiments were conducted to study the effects of the injected air flux in the oil yield, product oil quality, and process efficiency. Air injection fluxes ranged from 16 to 111 scfh/ft/sup 2/ and one test was conducted using steam dilution of the injected air. Regardless of the injected air flux, the oxygen consumption approached 100% and the combustion process became self-sustaining at ignition temperatures around 650-750°F (343-399°C). After ignition, all of the oxygen reacted with residual coke and the combustion temperatures increased to 1500-900°F (815-1035°C). Residual coke was the principal source of fuel for the combustion tests since the available coke, as determined by Fischer assay (36-39 wt. % initial bitumen), exceeded the fuel required for combustion. Other factors also indicated residual coke was the principal fuel: (1) oil production ceased before oxygen breakthrough, (2) unburned coke was measured on the lowermost spent sand, and (3) the calculated equivalent H/C ratio of the fuel burned was low.

14143 Mathematical modeling for in situ thermal recovery processes in tar sand: Model description and verification. Vaughn, P. (Western Research Institute, Laramie, WY 82070). *In Situ;* **11**: No. 2, 169-190(1987).

A fundamental model for numerically simulating the in situ thermal recovery of oil from a tar sand resource has been devel-

oped. This simulator generates results consistent with experimental findings. The numerical model accounts for the major phenomena that occur in the thermal processing of tar sand. The model accounts for the three-phase flow of oil, water, and gas. Mass transfer among the phases and components is dictated by liquid and vapor equilibria, reaction kinetics, reservoir properties, and processing conditions. Energy is transferred by the mechanisms of conduction, convection, reaction kinetics, and by vaporization and condensation. The solution technique employed in the model is based on a highly efficient method using the Newton-Raphson iteration scheme with a variable time-step algorithm. Results are compared with results of another numerical simulator as well as with results from a recent experiment conducted at WRI. These initial comparisons have shown good agreement and have identified areas for further improvement.

14144 **Saturate distributions in bitumens and in oils from tar sand: Effect of thermal processing.** Holmes, S.A.; Romanowski, L.J. Jr.; Thomas, K.P. (Western Research Institute, Laramie, WY 82071). *In Situ;* 11: No. 2, 117-144(1987).

Laboratory experiments using a linear, adiabatic tube reactor have been conducted to evaluate the potential of combustion and hot-gas injection for the thermal recovery of oil from samples of two tar sand deposits in Utah. Two bitumens and five thermally produced oils from samples of these deposits were analyzed for saturated hydrocarbon content and compound-type distributions. Significantly larger amounts of material with carbon numbers less than C/sub 40/ were present in product oils from combustion than were present in the original bitumens. The saturates in these product oils were comprised mostly of acyclic alkanes, mono-, and dicycloalkanes. Carbon number distributions of tetracyclo- and pentacycloalkanes (biological markers) were similar for both the product oil recovered by reverse combustion and the bitumen from Asphalt Ridge. The hot-gas injection process produced a greater amount of oil, containing more saturated hydrocarbons, than the combustion processes. Significant amounts of medium-molecular-weight material from C/sub 15/ to C/sub 37/ were present in oils produced by hot-gas injection. A comparison of the carbon number and Z-series distributions of saturates indicated that relatively greater amounts of branched alkanes and lower-numbered cyclic systems were present in product oils form combustion and hot-gas injection than in the original tar sand bitumens. The distributions of saturated hydrocarbons in produced oils reflected the severity of thermal processing and the quality of the recovered oil.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 14098, 14139, 14144

0406 Direct Uses And By-products

14145 **(AD-A—185744/0/XAB) Aviation turbine fuels from tar sands bitumen and heavy oils. Part 2. Laboratory sample production. Technical report, 1 April 1984-31 May 1985.** Moore, H.F.; Johnson, C.A.; Fabry, D.A.; Chaffin, M.H.; Sutton, W.A. (Ashland Petroleum Co., KY (USA)). Jul 1987. 136p. NTIS, PC A07/MF A01.

See also Part 1, AD-A151 319.

Phase II work performed on small bench-scale laboratory units was to validate the process variables identified in Phase I. As a part of this effort, samples (quantity 500 ML to 1000 ML) of JP4, JP8, were produced and submitted to AFWAL for their evaluation. Detailed characterizations of the tar sand feedstocks and product samples were performed. From the data generated in Phase II, specific goals and tests were outlined for Phase III of the program.

05 NUCLEAR FUELS

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 14240

14146 (EUR—10671, pp 160-162) **Activities in Geomicrobiology at the Federal Institute for Geosciences and Natural Resources, Hannover, (Germany, F.R.).** Bosecker, K. 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

The geomicrobiological research activity at the Federal Institute for geosciences and natural Resources (BGR) is concentrated mainly on the biodegradation of minerals and on the role of microorganisms involved in the extraction and solubilization of metals from ores and minerals. As far as the final disposal of radioactive wastes is concerned the influence of microorganisms may be neglected but with regard to tailings from the uranium industry the microbial effect must be taken into account and may give rise to new ways of short and long-term management of radioactive mining and milling tailings.

14147 **(NUCLEBRAS-CDTN—571) Calculation method of rate and area of sedimentation, by non-conventional mathematical process of data treatment.** Cota, P.L. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1987. 20p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700276/JAW.

The used methods for calculating the rate and area of sedimentation are based in techniques of graphical resolution. The solution of the problem by a mathematical resolution, using computational methods is faster and more accuracy. The comparison between the results from this methods and the conventional method is shown.

0504 Feed Processing

REFER ALSO TO CITATION(S) 14922

14148 **(FRNC-TH—3162) Contribution to the study of mass transfer: uranium extraction from phosphoric acid.** Maher, A. (Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). Dec 1985. 145p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751608/JAW.

Liquid-liquid extraction of uranium (VI) contained in phosphoric acid is examined. Synergism and thermodynamical equilibria are studied. Influence of drop size, extractant concentration and temperature on reaction kinetics are determined. The experimental study concerns extraction by HDEHP, TOPO and the mixture of both. Reaction mechanisms are interpreted.

14149 (INIS-mf—11095, pp 99-121) **Problems of nuclear fuel - provision, management.** Kubant, J.; Valvoda, Z. (Vyvojovy Zavod Uranoveho Prumyslu, Zbraslav nad Vltavou, Czechoslovakia. Ustav Jadernych Paliv). 9 Dec 1986. (In Czech). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88701081/JAW. (CONF-8610377—).

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

Some topical problems are discussed of the light water reactor fuel cycle with regard to the problems of nuclear fuel, its provision and nuclear fuel management in Czechoslovakia. The final product of the Czechoslovak uranium industry which is responsible for uranium ore prospecting, mining and processing, is a chemical concentrate of uranium, ammonium diuranate. The manufacturer and supplier of nuclear fuel for the Czechoslovak nuclear power plants is the USSR. Spent fuel is stored for three years in the tanks of the WWER reactor production units. It is then shipped to the USSR where its reprocessing is envisaged. The possibilities are

briefly outlined of cooperation in the manufacture of WWER fuel. Also presented are the main results of a study aimed at improved utilization of fuel in WWER's, which should lead to reducing the fuel component of the cost of electric power produciton by up to 10%. In this respect, the extension is envisaged of the fuel campaign to three years for WWER-1000 reactors and to four years for WWER-440 reactors. (Z.M.). 3 figs., 2 tabs., 4 refs.

0505 Uranium Enrichment

14150 **(CEA-CONF—9109) Laser and uranium isotope separation.** Gilles, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Jul 1987. 5p. (In French). (CONF-8707140—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751561/JAW.

From 1. international conference on materials, medicine biology, physics chemistry; Villeurbanne, France (7 Jul 1987).

Industrial processes for uranium enrichment, economical context and market are briefly reviewed. Then physical principles of the two lasers processes: SILMO (molecular process) and SILVA (atomic process) are presented insisting on criteria for choosing lasers used in the SILVA process which will be developed in France.

14151 **(INIS-GB—110) Urenco 1987.** (Urenco Ltd., Marlow (UK)). 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751832/JAW.

Urenco is a group of companies and production enterprises in the Federal Republic of Germany, the Netherlands and the United Kingdom. It was established in 1971 to develop and exploit on a commercial basis the enrichment of uranium by the gas centrifuge process. Its plants are at Almelo in the Netherlands, Capenhurst in the UK and Gronau in Germany. This report covers the year of operation to July 1987. The marketing (including the contracts made), production, plant details, tests and trials with recycled uranium, the technology of the process administration are all summarized. A financial statement of the year's operations is presented.

14152 **(K/D—5736) On-line vibration and analysis system at the Paducah Gaseous Diffusion Plant.** Herricks, D.M.; Strunk, W.D. (Paducah Gaseous Diffusion Plant, KY (USA); Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OU21400. 10p. (CONF-880220—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004484/JAW.

From 6. international modal analysis conference; Orlando, FL, USA (1 Feb 1988).

The enrichment facility in Paducah, KY uses a unique hardwired vibration monitoring and analysis system for gaseous diffusion equipment. The axial flow and centrifugal flow compressors used in uranium enrichment range in size from 6 feet in diameter to less than one foot in diameter. These compressors must operate smoothly and safely, without breech of containment, since the working fluid of gaseous diffusion is gaseous UF_6. The condition of 1925 compressors is monitored by use of the 2500 point vibration analysis system. Since the failure mechanisms of the compressors are well known and documented, only one accelerometer per machine is needed for most machines. The system is completely automated and can generate spectra or broadband levels in either acceleration or velocity units. Levels are stored for historical review. The analyst can, via a custom telecommunications link, view and analyze data from all monitored points with an office PC. 4 figs.

14153 **Investigation of technology for monitoring UF/sub 6/ mass flow.** Cooley, J.N.; Moran, B.W.; Swindle, D.W. Jr. (International Technology Programs, Oak Ridge Gaseous Diffusion Plant, Oak Ridge, TN 37831). *Journal of Nuclear Materials Management;* **16**: 766-770(Jul 1987). (CONF-870713—). Contract AC05-84OR21400.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

The applicability of gas flow meters, in-line enrichment monitors, and instruments for measuring uranium or UF/sub 6/ concentrations in process streams as a means for verifying declared plant throughput have been investigated. The study was performed to assist the International Atomic Energy Agency in the development of an effective international safeguards approach for aerodynamic uranium enrichment plants. Because the process gas in an aerodynamic enrichment facility is a mixture of UF/sub 6/ and H/sub 2/, a mass flow measurement in conjunction with a measurement of the uranium (or UF/sub 6/) concentration in the process gas is required to quantify the amount of uranium being fed into, and withdrawn from, the cascades for nuclear materials accountability verification. In line enrichment monitors developed for the U.S. gas centrifuge enrichment plant are found to be applicable only to pure UF/sub 6/ streams. Of the five gas flow meters evaluated, the orifice meter and the pilot tube meter are judged the best choices for the proposed applications: the first is recommended for low-velocity gas, small diameter piping; the latter, for high-velocity gas, large diameter piping. Of the six procedures evaluated for measurement of uranium or UF/sub 6/ concentration in a mixed process stream, infrared-ultraviolet-visible spectrophotometry is judged to be the best procedure currently available to perform the required measurement.

14154 **Improvements in collimator design for verification of uranium enrichment in gaseous centrifuge header pipes of diameter 4.45 cm and 10.16 cm.** Close, D.A.; Pratt, J.C. (Los Alamos National Lab., NM, USA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **257**: No. 2, 406-411(15 Jun 1987).

A technique that has been developed determines whether the process gas in a gaseous uranium centrifuge header pipe has an enrichment $\leq$ 20% or $>$ 20%. Improvements have been made in the detector collimator to improve the ability to discriminate between gas and deposit in the header pipes. The new detector collimator has been characterized for pipes having inner diameters of 4.45 and 10.16 cm. A statistical analysis indicates that this new design is well suited to the smaller diameter pipe.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 15065, 15113, 15370, 16937, 16970, 17022, 17056, 17057, 17059

14155 **Method for removal of plutonium impurity from americium oxides and fluorides.** Fitz Patrick, J.R.; Dunn, J.G.; Avens, L.R. (to Dept. of Energy, Washington, DC). US Patent 4,710,222. 1 Dec 1987. Filed date 13 Feb 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for the removal of plutonium impurity from oxides and/or fluorides of americium is described which comprises the steps of: a. reacting impure americium oxides containing plutonium impurity with fluorine gas to produce impure AmF/sub 4/; b. reacting the resulting impure AmF/sub 4/ with O/sub 2/F to produce PuF/sub 6/; and c. separating the PuF/sub 6/ from the AmF/sub 4/.

14156 **Critical experiments using high-enriched uranyl nitrate with cadmium absorber.** Lloyd, R.C.; Clayton, E.D.; Wilson, R.E.; McBroom, R.C.; Jones, R.R. (Pacific Northwest Lab., P.O. Box 999, Battelle Boulevard, Richland, WA 99352). *Nuclear Technology;* **79**: No. 1, 82-91(Oct 1987). Contract AC06-76RL01830.

The critical experiments reported provide data for the effect of a soluble neutron absorber (cadmium nitrate) on the criticality of high-enriched uranium nitrate solution. These data can be used in criticality control and for validation of calculational methods. The experiments were performed with cylindrical vessels of two different diameters, 241.8 and 291.6 mm. Cadmium concentrations used in the high-enriched uranium solution ranged up to — 11 gCd/iota. The vessels were reflected with water, and in some cases with water containing dissolved cadmium nitrate. The cadmium was found to be an effective neutron absorber when dissolved in the solution.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 14357, 14552, 14630, 15507, 15684

14157 (CEA-CONF—9064) Solvent extraction for the chemical separations of the 5f elements. Musikas, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Apr 1987. 35p. (CONF-870443—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751545/JAW.

From 2. international conference on the basic and applied chemistry of f-transition (lanthanides and actinides) and related elements; Lisbon, Portugal (6 Apr 1987).

After a brief account of the needs in actinides new extractants, the interest of N,N-dialkylamides and N,N'-tetraalkyles malonamides is shown. Results dealing mainly with the properties of N,N-dialkylamides as TBP alternate in irradiated fuel reprocessing are presented. They are: the selection of amides of which the uranyle nitrato adducts are soluble in alkanes; the extraction of: U(VI), Pu(IV) and fission products; the radiolytic and hydrolytic stability of amides and a bench scale test of N,N-di (2-ethylhexyl) hexanamide in a first reprocessing cycle. The N,N'-tetra or pentaalkyl malonamides extractive properties are described. They indicate that these completely incinerable extractants are very promising for the actinides recovery from the radioactive wastes. The needs in basic researches which lead to a best understanding of the actinides extraction chemistry are illustrated by some examples. 26 refs.

14158 (CEA-CONF—9089) Modelling of uranium/plutonium splitting in PUREX process. Boullis, B.; Baron, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Jun 1987. 9p. (CONF-8706249—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751553/JAW.

From EXTRACTION '87: meeting on solvent extraction techniques; Dounreay, UK (22 Jun 1987).

A mathematical model simulating the highly complex uranium/plutonium splitting operation in PUREX process has been achieved by the French "Commissariat a l'Energie Atomique". The development of such a model, which includes transfer and redox reactions kinetics for all the species involved, required an important experimental work in the field of basis chemical data acquisition. The model has been successfully validated by comparison of its results with those of specific trials achieved (at laboratory scale), and with the available results of the French reprocessing units operation. It has then been used for the design of French new plants splitting operations.

14159 (CEA-CONF—9090) Actinide extractants for the nuclear industry of the future. Musikas, C.; Morisseau, J.C.; Hoel, P.; Guillaume, B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Jun 1987. 11p. (CONF-8706249—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751554/JAW.

From EXTRACTION '87: meeting on solvent extraction techniques; Dounreay, UK (22 Jun 1987).

Non organo-phosphorus extractants properties regarding the extractions of actinides in nuclear fuels reprocessing are presented. N,N-dialkylamides are proposed as alternatives to TBP.N,N'-tetraalkylamides or pentaalkyl propane diamides properties are reported. They show that those bidentate extractants are alternatives to bidentate organophosphorus extractants for actinides (III) extraction from concentrated nitric acid. 11 figs, 15 refs.

14160 (CEA-CONF—9091) Pu(IV)-dibutylphosphate complexes in the Purex process. Pasquiou, J.Y.; Livet, J.; Germain, M.; Musikas, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Jun 1987. 10p. (CONF-8706249—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751555/JAW.

From EXTRACTION '87: meeting on solvent extraction techniques; Dounreay, UK (22 Jun 1987).

HDBP forms in aqueous phases insoluble actinides complexes. When present in organic phases it precludes the quantitative Pu(IV) back-extraction. Several methods, used to remedy to HDBP drawbacks are described.

14161 (CEA-R—5411) Dialkyldithiophosphoric acids - chemical properties and 5f and 4f elements ions extraction. Pattee, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Sep 1987. 251p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88751848/JAW.

This work is a contribution to the study of the properties of the dialkyldithiophosphoric acids and of the extraction of the 4f and 5f ions from weakly acidic nitrate and phosphate media. Following a complete bibliographic study, synthesis and purification of the di-2-ethylhexyl-dithiophosphoric acid (HDEHDTP) is studied. It is identified with chemical methods and spectroscopic methods (I.R., N.M.R., V.P.C.); its by products, the di-2-ethylhexyl (monothio) phosphoric acids ((HDEHTP, HDEHP) are also identified and characterized. Stability against hydrolysis and radiolysis is determined. The extractive properties are studied for the 4f and 5f ions. The presence of a sulfur donor atom in HDEHDTP makes it inefficient for the extraction of trivalent lanthanides and actinides but brings out a certain selectivity for americium. For HDEHTP, the presence of an oxygen donor atom rubs out any selectivity and the extraction constants are greater. Selectivity of HDEHDTP is increased by TBP (tri-n-butylphosphate) in synergistic mixtures. The mechanism of extraction of hexavalent uranium from phosphoric medium is elucidated. A model is developed by NMR for the micellisation of the sodium salts of HDEHDTP, HDEHTP and HDEHP, and extrapolated it to the trivalent rare earth salts of the acids. The structures are verified by light scattering and low angle X-ray diffraction.

14162 (CONF-880220—8) Dynamic considerations in the development of centrifugal separators used for reprocessing nuclear fuel. Strunk, W.D.; Singh, S.P.; Tuft, R.M. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003775/JAW.

From 6. international modal analysis conference; Orlando, FL, USA (1 Feb 1988).

The development of centrifugal separators has been a key ingredient in improving the process used for reprocessing of spent nuclear fuel. The separators are used to segregate uranium and plutonium from the fission products produced by a controlled nuclear reaction. The separators are small variable speed centrifuges, designed to operate in a harsh environment. Dynamic problems were detected by vibration analysis and resolved using modal analysis and trending. Problems with critical speeds, resonances in the base, balancing, weak components, precision manufacturing, and short life have been solved.

14163 (DP-MS—87-115) Mathematical modeling of heat transfer in Pu-238 ion exchange columns. Wehner, J.A. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 20p. (CONF-8710146—1-Vugraphs). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014836/JAW.

From Plutonium/uranium recovery operations conference; Richland, WA, USA (12 Oct 1987).

The safety of increased Pu-238 loading on the larger ion exchange columns to be installed in the H-Canyon Frames was examined from the standpoint of the temperature increase of a fully-loaded column, following a flow interruption. A mathematical model incorporating self-heating and resin degradation was developed. Transient temperature profiles generated by this model indicate that the column loading limits may be safely scaled up in proportion to the column diameters. This model was also used to demonstrate that a short agitation period following an incomplete product elution step will appreciably decrease the maximum temperature rise of the resin bed.

14164 (DPST—87-386) RTA 1306-S: Evaluation of in-line mixers to replace FB-line M2 precipitators: Part 1, Optimum dimensions for a mixing "T". Chang, T.P. (Savannah River Lab., Aiken, SC (USA)). 14 Apr 1987. Contract AC09-76SR00001. 8p. NTIS, PC A02. Order Number DE88003503/JAW.

Separations Technology, Separations, and the Actinide Technology Division (ATD) are engaged in a development program to evaluate replacing the current FB-Line first stage precipitators (M2) with mixing "T"s or static mixers. The incentives include increased utility and improved product quality. In addition, decreased radiation exposure can also be realized through easy maintenance of the mixing "T" or static mixers. This report documents the references and procedures used to design a mixing "T" as well as the results. The optimum dimensions of a mixing "T" for use in FB-Line to premix a small amount of hydrofluoric acid (HF) with a relatively large volume of the plutonium (Pu) feed has been calculated. The pipe should have an inside diameter (ID) of 1/8" in order to achieve Reynolds number (Re) greater than 7×10^3 for the Pu feed stream. The HF should be introduced through a 1/64" ID jet. The length of the mixing tube should be not shorter than 11 cm. For this configuration, a pump will be needed to provide the additional head required for the HF jet. Specification of static mixers is in progress and will be presented in a separate report. A detailed test program regarding the testing facilities, schedule, and methods will be issued later.

14165 (EUR—10548) Testing of a remotely operable deep bed packed glass fiber mist eliminator as a high efficiency prefilter for aerosol retention in a reprocessing plant (EC Final Report). Furrer, J.; Linek, A. (Commission of the European Communities, Luxembourg). 1986. 54p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751735/JAW.

The report outlines the results of testing aerosol retention at the packed fiber mist eliminator and an estimate of the service life of such a prefilter in reprocessing plants. The aerosol source terms upstream of the packed fiber mist eliminator as determined during operation according to specification of the WAESCHE facility were found to be attributable by 5.8 x 10/sup -5/ mol/std. m/sup 3/ to shear dust produced during one hour of simulation of the shearing process and by 1.6 x 10/sup -7/ mol/std. m/sup 3/ to salts produced during nine hours of dissolving process. It appeared that much higher aerosol concentrations cause loading of the offgas test section in the course of fuel element shearing. As a result of the tests and upgradings of the packed fiber mist eliminator, both performed from 1980 until 1984, it was possible to demonstrate that the whole component consisting of filter housing and filter element can be applied reliably. Given the high availability of the mist eliminator in the dissolver offgas of at least 250 days per year without requiring any cleanup of the fiber pack, the packed fiber mist eliminator used as prefilter of the HEPA filter is one of the offgas cleaning components requiring the least amount of maintenance work. On account of its high retention factor for aerosols of > 500 the time-to-failure of the subsequent HEPA filters is considerably increased. Due to the compactness of its design the packed fiber mist eliminator can serve as a barrier against shock overpressures and droplet clusters in an accident.

14166 (EUR—10823) Characterization of insoluble dissolver residues and the development of treatment methods. Baker, H.T.; Brown, P.E.; Pateman, R.J.; Wilkinson, K.L. (Commission of the European Communities, Luxembourg). 1986. 74p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751594/JAW.

Characterization studies have been carried out on the insoluble residue arising from laboratory scale dissolution of single pins of mixed oxide fuel irradiated in the Dounreay Fast Reactor (DFR). Similar characterization work has also been completed on six samples of insoluble residue recovered from the reprocessing of complete sub-assemblies of mixed oxide fuel irradiated in PFR. Treatment methods for the dissolver insolubles have consisted of preparing immobilized samples in sand/ordinary portland cement (OPC), sand/pulverized fly ash (PFA)/OPC, and blast furnace slag (BFS)/OPC. A programme of leach testing has been carried out according to the conditions laid down in the international Standard Organization Test. Four samples of DFR originated insoluble residues and six samples of PFR originated insoluble residues have been immobilized and leach tested. Variations have included experiments to evaluate the leach rate under temperature influence and to acid wash prior to immobilization.

14167 (ND-R—1217(D)) Measurement of uranium and plutonium using isotope excited K-shell X-ray fluorescence. Sarstedt, K.J.; Skea, D.C.J.; Adaway, D.W. (UKAEA Risley Nuclear Power Development Establishment). Sep 1986. 16p. H.M. Stationery Office, London, price $4.00.

The technique of isotope excited X-ray fluorescence has been used to measure plutonium and uranium concentrations in mixed solutions. A wide range of U/Pu concentrations and ratios were studied to give information on mutual interactions. A multiple regression on the intensity data using the stepwise procedure (as far as the intensity squared terms) has given equations relating intensities to uranium and plutonium concentrations. Only statistically significant terms were retained in the model. The terms in the equations can be associated with self-absorption and enhancement effects.

14168 (ND-R—1343D) Method for the separation of uranium from plutonium concentrates and subsequent colourimetric measurements as the bromo-PADAP complex. Mair, M.A.; Savage, D.J. (UKAEA Risley Nuclear Power Development Establishment). Aug 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750870/JAW.

Uranium is separated from plutonium and other impurities by solvent-extraction using tributyl phosphate/odourless kerosene (TBP/OK). The uranium in solvent is measured colourimetrically using the sensitive chromogenic reagent bromo-PADAP (2-(5-bromo-2-pyridylazo)-5-(diethylamino) phenol).

14169 (ND-R—1344(D)) Uranium mass transfer between dilute HNO_3 and 30% TBP/OK. Craig, D.R. (UKAEA Risley Nuclear Power Development Establishment). Nov 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750960/JAW.

Measurement of mass transfer rate coefficients for the system uranyl nitrate/30% tributyl phosphate in odourless kerosene/nitric acid is described in this report. Uranium mass transfer from both aqueous phase to the organic phase and from the organic phase to aqueous phase was studied over a range of uranium concentrations. Organic phase to aqueous phase transfer showed no dependence on uranium concentration over the ranges studied. Aqueous phase to organic phase transfer may be concentration dependent below 50 g/l uranyl nitrate and further work is needed. Both organic phase to aqueous phase and aqueous phase to organic phase transfer showed a dependence on the aqueous phase acidity.

14170 (ND-R—1345(D)) Plutonium mass transfer between dilute HNO_3 and 30% TBP/OK. Craig, D.R. (UKAEA Risley Nuclear Power Development Establishment). Nov 1986. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750961/JAW.

Measurement of mass transfer rate coefficients for the system plutonium (IV) nitrate/30% tributyl phosphate in odourless kerosene/nitric acid is described in this report. Plutonium mass transfer behaviour for both the aqueous phase to organic and for the organic phase to aqueous phase was studied over a range of plutonium concentrations. For aqueous phase to organic phase transfer an increase in mass transfer rate coefficient with plutonium concentration was observed, consistent with interfacial turbulence phenomena enhancing the mass transfer process. A change in mass transfer rate coefficient was found for the case of organic phase to aqueous phase transfer of plutonium, but this is not thought to be significant and further work is required. Both organic phase to aqueous phase and aqueous phase to organic phase transfer showed a dependence on the aqueous phase acidity.

14171 **(ND-R—1380(D)) Mixed uranium and plutonium mass transfer between 3.0m nitric acid and 20% tributylphosphate in odourless kerosene.** Craig, D.R. (UKAEA Risley Nuclear Power Development Establishment). Nov 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750962/JAW.

Measurement of mass transfer rate coefficients for the mixed system uranyl and plutonium (IV) nitrates/20% tributyl phosphate in odourless kerosene/nitric acid is described. Only aqueous phase to organic phase transfer was investigated. Uranium mass transfer and plutonium mass transfer behaviour were both studied over a range of uranyl nitrate/plutonium (IV) nitrate concentrations. For both uranyl nitrate and plutonium (IV) nitrate, no dependence upon uranyl and plutonium (IV) concentration was found over the ranges studied.

14172 **(ORNL/TM—10458) Process monitoring in support of International Atomic Energy Agency safeguards.** Ehinger, M.H.; Wachter, J.W.; Hebble, T.L.; Kerr, H.T. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 46p. (ISPO—275). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001521/JAW.

A review of previous efforts in process monitoring for safeguards was conducted. Previous efforts touched on various concepts and a few specific applications, but none was comprehensive in addressing all aspects of a process monitoring application for safeguards. This report develops prototypical process monitoring concepts that can be incorporated into the International Atomic Energy Agency's (IAEA's) general safeguards approach for fuel reprocessing plants. This effort considers existing approaches, recognizing limitations and needed improvements. Prototypical process monitoring applications are developed and proposed for implementation and demonstration in the Integrated Equipment Test facility, which is located at the Oak Ridge National Laboratory. The specific information needed to accomplish the process monitoring objectives are defined, and the mechanics for obtaining that information are described. Effort is given to the identification and assessment of potential impacts and benefits associated with process monitoring concepts, with particular attention to IAEA, state, and plant operator interests. The historical development of process monitoring is described and the implications of using process monitoring in international safeguards are discussed. Specific process process monitoring applications for demonstration in the IET facility are developed in Sects. 6 through 14. 1 fig.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 14209, 14232, 14343, 14344, 14345, 14552, 14575

14173 **(AEEW-R—1706-Vol.1) System of large transport containers for waste from dismantling light water and gas-cooled nuclear reactors. Volume 1.** Price, M.S.T.; Lafontaine, I. (UKAEA Atomic Energy Establishment, Winfrith; Department of the Environment, London (UK)). Sep 1986. 129p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750907/JAW.

General descriptions of the main types of reactors in the European Economic Community are given, a series of reference plants selected for further study. Estimates are made of the radioactive decommissioning wastes for each, including neutron-activated and contaminated materials. Regulations governing the transport of radioactive materials, both international and national, are reviewed. (U.K.).

14174 **(AEEW-R—1706-Vol.2) System of large transport containers for waste from dismantling light water and gas-cooled nuclear reactors. Volume 2.** Price, M.S.T.; Lafontaine, I. (UKAEA Atomic Energy Establishment, Winfrith; Department of the Environment, London (UK)). Sep 1986. 123p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750908/JAW.

This report deals with the operational, radiological and economic aspects of transport as well as conceptual designs of large containers for the transport of radioactive decommissioning wastes from nuclear power plants within the member states of the European Economic Community. The means of transport, the costs and radiological detriment are considered, and conceptual designs of containers are described. Recommendations are made for further studies. (U.K.).

14175 **(IAEA-TECDOC—413) Competent authority regulatory control of the transport of radioactive material.** (International Atomic Energy Agency, Vienna (Austria)). Apr 1987. 59p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700180/JAW.

The purpose of this guide is to assist competent authorities in regulating the transport of radioactive materials and to assist users of transport regulations in their interactions with competent authorities. The guide should assist specifically those countries which are establishing their regulatory framework and further assist countries with established procedures to harmonize their application and implementation of the IAEA Regulations. This guide specifically covers various aspects of the competent authority implementation of the IAEA Regulations for the Safe Transport of Radioactive Material. In addition, physical protection and safeguards control of the transport of nuclear materials as well as third party liability aspects are briefly discussed. This is because they have to be taken into account in overall transport regulatory activities, especially when establishing the regulatory framework. 32 references.

14176 **(IAEA-TECDOC—423) Recommendations for providing protection during the transport of uranium hexafluoride.** (International Atomic Energy Agency, Vienna (Austria)). Jun 1987. 78p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700616/JAW.

In July 1986 a group of consultants was convened by the IAEA to provide initial guidance on the transport of UF/sub 6/ and the regulations for it considering the hazards posed by this material. A Technical Committee meeting was held in November 1986 to finalize the development of the recommendations for providing protection during the transport of UF/sub 6/. This report provides the recommendations resulting from the meetings of these experts. The IAEA recommends that national competent authorities and other relevant national regulatory and standards-related organizations, and appropriate international organizations seriously consider all of the information provided in this report especially the additional requirements set forth in Section III.3 concerning design, manufacturing and testing requirements, design approval requirements, requirements on loading for transport, and requirements for quality assurance and maintenance. This report also deals with United Nations' Recommendations of the Transport of Dangerous Goods, International Modal Regulatory Documents, ANSIN14.1-1982 and ISO/DIS/7195 Standards. Refs, figs and tabs.

14177 **(PNL—5882) Categorization of failed and damaged spent LWR [light-water reactor] fuel currently in storage.** Bailey, W.J. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 269p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88004596/JAW.

The results of a study that was jointly sponsored by the US Department of Energy and the Electric Power Research Institute are described in this report. The purpose of the study was to (1) estimate the number of failed fuel assemblies and damaged fuel assemblies (i.e., ones that have sustained mechanical or chemical damage but with fuel rod cladding that is not breached) in storage, (2) categorize those fuel assemblies, and (3) prepare this report as an authoritative, illustrated source of information on such fuel. Among the more than 45,975 spent light-water reactor fuel assemblies currently in storage in the United States, it appears that there are nearly 5000 failed or damaged fuel assemblies. 78 refs., 23 figs., 19 tabs.

14178 **(SAND—85-2129) Test data report for quarter scale NuPac 125-B Rail Cask model.** Warrant, M.M.; Joseph, B.J. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 281p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88005250/JAW.

This report describes the testing conducted and presents the data obtained by Sandia National Laboratories on a quarter scale model of the NuPac 125-B Rail Cask. Three 30-ft free-fall impact tests and two 40-in. free-fall drops onto a puncture bar were performed. The 30-ft drop tests consisted of one end drop onto the bottom impact limiter, an oblique drop on to the closure-end impact limiter, and a flat drop onto both impact limiters on the exterior of the package. The 40-in. puncture tests were directed at the centers of the side and closure end of the package. The five tests were conducted to verify the structural adequacy of the package for the hypothetical accident conditions specified in 10CFR71 and to define the accident damage as initial conditions for the thermal, shielding, and criticality analyses. 5 refs., 160 figs., 30 tabs.

14179 **The transportation institutional plan: Cooperative planning for NWPA transportation.** Denny, S.H.; Livingston-Behan, E.A. (Office of Civilian Radioactive Waste Management, U.S. Dept. of Energy, Washington, DC 20585). pp 197-202 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Transportation Institutional Plan, published in 1986 by the U.S. Department of Energy's Office of Civilian Radioactive Waste Management (OCRWM), defines a process for effective interaction among those who may be affected by transportation activities conducted under provisions of the Nuclear Waste Policy Act of 1982 (NWPA). The Plan describes formal mechanisms for identifying, addressing, and resolving specific transportation issues. An appendix to the Plan includes detailed discussion of the following transportation issues: (1) the transportation of defense waste; (2) prenotification; (3) physical and rail shipments; (4) highway routing; (5) rail routing; (6) inspection and enforcement for highway and rail shipments; (7) emergency response; (8) liability coverage for transportation to NWPA facilities; (9) cask design and testing; (10) overweight truck shipments; (11) rail service analysis; (12) mixture of transportation modes; (13) transportation infrastructure improvements; (14) OCRWM training standards; (15) transportation operational procedures; and (16) State, Tribal, and local regulation of transportation. The OCRWM's intent is to provide an open accounting of planning, to identify opportunities for public involvement in program activities, and to foster communication and negotiation in the cooperative development of a safe, efficient, and cost-effective NWPA transportation program.

14180 **Safe but controversial: A study of recent high-visibility spent fuel shipping campaigns.** Grimm, P.D.; Harmon, L.H. (U.S. Dept. of Energy, Washington, DC 20545). pp 217-222 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Since the need to move radioactive materials is at the core of every part of the fuel cycle, it is not surprising that the waste management program also has a critical transportation link. Yet, in spite of a nearly flawless safety record, transportation of spent fuel is an extremely controversial and emotional issue. There are reactions at every political level and pressures from special interest groups across the Nation. In many cases the courts make the final decisions. An example is the DOE program to move spent fuel from Brookhaven National Laboratory which took ten years to accomplish and wound up being decided by the U.S. Supreme Court. Two other DOE shipping campaigns now underway contain all of the same elements of controversy. About 35 - 40 rail shipments are intended to move the damaged Three-Mile Island core to DOE's Idaho facility. In addition, approximately 50 shipments of spent fuel will be made from the VEPCO plant at Surry, Virginia, to Idaho for use in testing above-ground storage methods. This paper traces the background of the campaigns and the controversies generated. Comparisons and contrasts of "routine" shipments of recent years with problems of today, including lawsuits to prevent shipment, are given along with implications for the future.

14181 **Transportation of spent fuel to the Idaho National Engineering Laboratory.** Gertz, C.P.; Schoonen, D.H.; Wakeman, B.H. (Idaho National Engineering Lab., Dept. of Energy - Idaho Operations, Idaho Falls, ID 83402). pp 397-404 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Spent fuel research and development demonstrations and associated transportation activities are being performed for the Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM) as a part of the storage cask performance testing programs at the Idaho National Engineering Laboratory (INEL). The shipment of spent fuel to the INEL from the Surry Power Station and the Nevada Test Site (NTS) required shipping plans and coordination between DOE, EG and G Idaho, Transnuclear, Inc., (the shipping cask supplier) and Virginia Power (VP) transportation personnel for the VP shipments; included Westinghouse Nevada Operations for the NTS shipments; as well as extensive communication with the corridor states. Similar extensive planning and coordination with DOE; Nuclear Regulatory Commission (NRC); General Public Utilities (GPU) Nuclear Corporation [owner and operator of Three Mile Island Unit 2 (TMI-2)]; EG and G Idaho, Inc.; two railroad companies; and state and city officials were required to initiate the shipments of core debris by railroad from TMI-2 to the INEL.

14182 **TRANSNET - A user-accessible network of transportation analysis models.** Cashwell, J.W. (Sandia National Labs., Albuquerque, NM 87185). pp 423-426 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Models and associated data bases, developed under the sponsorship of the Department of Energy (DOE) through the Transportation Technology Center at Sandia National Laboratories, have been used to support transportation analysis efforts for specific sites and for the assessments of the impacts of transportation of specific waste forms to processing/storage sites. TRANSNET, an interactive computer network, was developed to allow outside users access to these models. TRANSNET contains the most recent versions of models developed under DOE/TTC sponsored--code modifications that have been made since the last published documentation is noted to the user on the TRANSNET screens. To permit a greater spectrum of users to utilize the models, considerable attention has been given to making the models user-friendly and in providing default data sets for typical problems. TRANSNET access and use is limited to support of DOE related program activities; for such activities there are currently no access or user charges.

14183 **Satellite tracking of radioactive shipments - High technology solution to tough institutional problems.** Harmon, L.H.; Grimm, P.D. (U.S. Dept. of Energy, Washington, DC 20545). pp 427-430 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Three troublesome institutional issues face every large-quantity radioactive materials shipment. They are routing, pre-notification, and emergency response. The Transportation Communications System (TRANSCOM), under development by DOE, is based on a rapidly developing technology to determine geographical location using geo-positioning satellite systems. This technology will be used to track unclassified radioactive materials shipments in real-time. It puts those charged with monitoring transportation status on top of very shipment. Besides its practical benefits in the areas of logistics planning and execution, it demonstrates emergency preparedness has indeed been considered and close monitoring is possible. This

paper describes TRANSCOM in its technical detail and DOE plans and policy for its implementation. The state of satellite positioning technology and its business future is also discussed.

14184 **Point kernel versus radiation transport for iron deep penetration problems.** Broadhead, B.L.; Parks, C.V. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **54**: 295-296(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The purpose of this study was to determine the relative merits and adequacy of the QAD-CG and QAD-CGGP point kernel codes for spent fuel shielding problems by comparing gamma dose results with those of several radiation transport codes: DOT IV, MORSE SGC, XSDRNPM-S, and MCNP. An intercomparison of results from the radiation transport codes was of secondary interest. The problem considered was an R-Z spent fuel cask model consisting of a homogenized source region (UO_2 fuel + basket) surrounded by a 38-cm-thick cast iron body. The total cask height is 530 cm. Photon source strengths for eight different discrete energy lines (0.6 to 2.8 MeV) were specified.

0510 Marketing, Economics, And By-products

REFER ALSO TO CITATION(S) 14226

0520 Waste Management

REFER ALSO TO CITATION(S) 14166, 14335, 14335, 14342, 14592, 14769, 14902, 14905, 14906, 15166, 15167, 15350, 15352, 15490, 15542, 15543, 16049, 16050, 16084, 16085, 16086, 16090

14185 **(AEEW-M—2000) Immobilisation of shredded soft waste in cement monolith.** Brown, D.J.; Dalton, M.J.; Smith, D.L. (UKAEA Atomic Energy Establishment, Winfrith). Apr 1983. 25p. (PCMWP—83-P20). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750919/JAW.

A grouting process for the immobilisation of shredded contaminated laboratory waste in a cement monolith is being developed at the Atomic Energy Establishment Winfrith. The objective is to produce a 'monolithic' type package which is acceptable both for sea and land disposal. The work carried out on this project in the period April 1982 - March 1983 is summarised in this report.

14186 **(AEEW-R—1948) Dimensional stability and elastic modulus of cemented simulant Winfrith reactor (SGHWR) sludge.** Holland, T.R.; Lee, D.J. (UKAEA Atomic Energy Establishment, Winfrith; Department of the Environment, London (UK)). Dec 1985. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750863/JAW.

Dimensional changes and elastic modulus have been monitored on cemented simulant sludge stored in various environments. Specimens prepared using a blended cement show no serious detrimental effects during sealed storage, underwater storage or freeze/thaw cycling.

14187 **(AEEW-R—1949) Leachability of cemented Winfrith reactor sludge.** Holland, T.R. (UKAEA Atomic Energy Establishment, Winfrith; Department of the Environment, London (UK)). Aug 1985. 38p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750837/JAW.

This report summarises the leach testing of cemented Winfrith reactor sludge specimens, prepared during 1984. Both semi-dynamic and static leach tests are reported. Updated results obtained from specimens prepared in 1982 have been included for comparison. The impact of these results on the full scale storage situation has been addressed.

14188 **(AEEW-R—1961) Immobilisation of MTR waste in cement (product evaluation). Annual report March 1985.** Howard, C.G.; Smith, D.L.G.; Williams, J.R.A. (UKAEA Atomic Energy Establishment, Winfrith). Jan 1986. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750856/JAW.

This report describes work performed at Winfrith under the UKAEA's research and development programme on radioactive waste management. The work carried out during April 1984 to March 1985 on the evaluation of laboratory and 200 dm^3 scale products of cemented MTR waste was sponsored by the Department of the Environment as part of radioactive waste management research programme. The results will be used in the formulation of Government policy but at this stage they do not necessarily represent Government policy.

14189 **(AEEW-R—2008) Characterisation and immobilisation of Winfrith reactor (SGHWR) wastes - annual report September 1985.** Holland, T.R.; Lee, D.J. (UKAEA Atomic Energy Establishment, Winfrith; Department of the Environment, London (UK)). Sep 1985. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750862/JAW.

Progress is reported in a programme to characterise both the sludge wastes generated during operation and maintenance of the Winfrith SGHWR, and the solidified end product after cementation. The main programme includes the preparation of more representative simulant sludges, the effect of scale on process parameters and product properties, continued tests on cemented sludge, the active demonstration of sludge homogenisation, sludge dewatering, the characterisation of homogenised active sludge and data evaluation and report presentation.

14190 **(AERE-G—3514) Solidification of highly active wastes. Annual reports for contracts carried out in the period 1 April 1984 to 31 March 1985.** Morris, J.B. (comp.). (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Engineering Div.; UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.; Department of the Environment, London (UK)). Jul 1986. 213p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750855/JAW.

This document contains the annual reports for the contracts: (A) Glass Technology; (B) Calcination of Highly Active Waste Liquors; (C) Formation and Trapping of Volatile Ruthenium; (D) Deposition of Ruthenium; (E) Enhancement of Off-Gas Aerosol Collection; (F) Volatilisation of Cs, Tc and Te in High Level Waste Vitrification.

14191 **(AERE-G—3588) Solidification of highly active wastes. Final reports for contracts carried out in the period 1 April 1984 to 30 June 1985.** Morris, J.B. (comp.). (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Engineering Div.). Jul 1986. 72p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750830/JAW.

The paper contains the annual reports to the Department of the Environment's Radioactive Waste Management Research Programme [1984/1985] on a joule ceramic melter [JCM] and glass compositions for the Prototype Fast Reactor (PFR) waste. The contract work on the JCM concerned a small prototype JCM, and included: glass-making campaigns, dismantling, design improvements, higher temperature glasses, electrode corrosion, and experimental test melter. The contract work for PFR waste included: glass technology, experimental techniques, glass development for radioactive wastes, and compatibility of melter metals with PFR glasses. (U.K.).

14192 **(AERE-G—3777) Active liquid treatment by a combination of precipitation and membrane processes. Final report to the CEC covering the period October 1980-June 1985.** Gutman, R.G.; Cumming, I.W.; Williams, G.H. (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Engineering Div.). Aug 1986. 99p. (LETTF—86-P28). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750831/JAW.

New ultrafiltration processes developed for the treatment of low and medium active radioactive wastes, were applied successfully to a variety of simulated and real wastes, including magnesium alloy clad spent storage fuel pond waters, reprocessing plant solvent wash liquors, plutonium production effluents and mixed site effluents. After initial laboratory scale feasibility experiments the

process was scaled up successfully, using a variety of different ultrafiltration modules. The information accumulated on membrane performance, membrane fouling and flux restoration techniques, and ancillary equipment performance was used to design a much larger demonstration pilot plant. This plant has been constructed and is now processing continuously each day over $1m^3$ of a real radioactive effluent.

14193 **(AERE-G—3857) Study on the behaviour of inorganic ion exchangers in the treatment of medium active effluents. Part II - effect of gamma irradiation on absorber performance.** Phillips, B.A.; Hooper, E.W.; Monckton, N.P. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.; Department of the Army, Williamsburg, VA (USA). Directorate of Transportation). Jul 1986. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750815/JAW.

This report summarises some of the results from an ongoing experimental programme of work for the Department of the Environment on the potential use of inorganic ion exchangers for the treatment of medium active waste streams. The effect of irradiation up to a total dose of 10 M Gy on the absorption of fission products and actinides over a range of experimental conditions by selected ion exchangers is described. The ion exchangers tested were polyantimonic acid, hydrous titanium oxide, manganese dioxide, potassium copper hexacyanoferrate II, titanium phosphate and zirconium phosphate. Manganese dioxide and potassium copper hexacyanoferrate II were unaffected by irradiation. Polyantimonic acid showed a decreasing performance with increasing total dose. Zirconium phosphate, titanium phosphate and oxide showed a decreasing performance up to a total dose of 2.19 M Gy with an apparent recovery in performance on increasing the total dose to 10 M Gy. The effect of conditioning time on some of the irradiated absorbers could have influenced the uptake data above 1.25 M Gy.

14194 **(AERE-G—4010) Preparation of Synroc and its radiation stability. Progress report July 1986.** Evans, J.P.; Boult, K.A.; Paige, E.L.; Marples, J.A.C. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.). Dec 1986. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750967/JAW.

Samples of Synroc have been made from simulated Highly Active Waste and 'Sandia' precursor supplied by the Australian Atomic Energy Commission, with a view to gaining experience for making fully active samples. The Synroc pellets were of good density (approx. $4.5 g.cm^{-3}$), and and with comparable leach rates to samples made in Australia but the micro-structure was rather coarser. Some Pu-238 doped pellets made previously from low surface area precursors but with the correct phase structure have now received a radiation dose equivalent to an age of 400,000 years for Synroc containing fully active waste. The samples are still intact but their volumes have increased by 6%, in agreement with Australian results on samples damaged by neutron irradiation.

14195 **(AERE-M—3551) Monitoring of ruthenium in process gases in vitrification plants.** Cains, P.W. (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Engineering Div.; Department of the Environment, London (UK)). Dec 1986. 15p. H.M. Stationery Office, London, Price Pound 4.00.

This review aims to identify monitoring methods for volatile and particulate forms of ruthenium suitable for use under vitrification process operating conditions. In the upstream parts of the plant, volatile ruthenium samples may be collected by liquid absorption, and subsequently analysed by conventional techniques. A recent development (ICP-mass spectrometry) may improve inactive detection limits by several orders of magnitude in future. Particulate ruthenium may be sampled using standard stack sampling methods. In downstream parts of the off-gas purification plant, and in stack effluents, the radiometric detection of $^{106}Ru/^{106}Rh$ by β-or γ-monitoring is the only approach likely to give adequate sensitivity. It should be possible to collect particulate ruthenium on filters; volatile ruthenium may in principle be monitored directly in the gas stream, or after removal and concentration by dissolution or adsorption. No such systems have been developed to date.

14196 **(AERE-R—11826) Initial appraisal of aspects of quality assurance in the conditioning of radioactive wastes. Part 1 - quality control and process modelling.** Taylor, R.F.; Fellingham, L.R.; Purcell, A.M. (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Engineering Div.). Sep 1986. 101p. H.M. Stationery Office, London, price Pound 7.00.

Basic methodology is presented for examining proposed HLW and ILW waste conditioning processes to identify the quality control and assurance measures to be adopted for both the products and the processes employed. Within the comprehensive quality assurance plan necessary for all radwaste immobilisation schemes an integrated set of features are set out embodying for the product: product fitness quality characteristics; product model; plant product specification; and for the process: process model; process specification; process monitoring and recording procedure. Examples of these sets of features are provided as a basis for adoption and extension on developing process routes. Details of some models and specifications are provided in appendices to aid examination and to invite augmentation and improvements. Standard sampling and inspection procedures and process control methods are briefly reviewed as directed to radwaste processing and package. A substantial appendix examines the application of quality control methods to a specific case of cemented ILW.

14197 **(AERE-R—11904) Polymer and bitumen modified OPC for the immobilisation of ILW.** Johnson, D.I.; Worrall, G.; Phillips, D.C. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.; Department of the Environment, London (UK)). May 1986. 59p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750814/JAW.

A detailed study has been made of the modification of ordinary Portland cement with polymeric additives, and of the properties of waste forms based on these matrix materials. The additives were styrene butadiene and bitumen emulsions, and epoxide and polyurethane resins: the simulated wastes were organic ion exchanger beads, PWR evaporator concentrate, reprocessing concentrate and Magnox metal. The effect of polymer:cement (p:c) and water:cement ratios on the properties of the hardened cement paste has been comprehensively investigated. Substantial increases in strain to failure, and modest reductions in permeability to water and leach rates for ^{137}Cs, are obtained at $p:c >= 0.2$. Much larger volume fractions of organic ion exchange beads can be encapsulated in polymer modified OPC than in unmodified OPC, perhaps because of their better strain capability. The radiation stability of cemented PWR evaporator concentrate is better for a polymer modified matrix than an unmodified OPC matrix. Two hundred litre trials have been successfully demonstrated.

14198 **(AERE-R—11966) Review of techniques for partitioning highly active waste.** Thompson, R. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.). Jun 1986. 29p. HMSO, London, price Pound 4.00.

A review is given of techniques available or proposed for the partitioning of actinide and long-lived fission products from highly active waste produced in the nuclear fuel cycle. The nature of the waste is considered and specific schemes that have been developed for partitioning are described. Most of these are based on solvent extraction using organic extractants such as tri-n-butyl phosphate, TBP, de-2-ethylhexyl phosphoric acid, HDEHP, and bifunctional reagents such as dihexyl-N,N-diethylcarbamyl methylene phosphonate, CMP, or octyl phenyl-N,N-diisobutylcarbamyl methylene phosphine oxide, CMPO. Some schemes are in an advanced state of development and could form the basis of a partitioning plant. The costs of partitioning, however, using these techniques are not justified by the reduction in the radiological hazard of the waste. Methods other than solvent extraction are considered and suggested. These need further development but may offer cost savings if partitioning is ever thought desirable. It is suggested that savings could be made by processing the waste in a condensed form (at the evaporation, calcination or molten glass stage) so that smaller plant would be required. High temperature techniques would have to be used for this, such as molten salt transport for counter-current ion migration.

14199 **(AERE-R—12066) NEARSOL - a simple program to model actinide speciation and solubility under waste disposal conditions. A user's guide.** Leach, S.J.; Pryke, D.C. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.). May 1986. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750838/JAW.

A simple program, NearSol, has been written in Fortran 77 on the Harwell Central Computer to model the aqueous speciation and solubility of actinides under near-field conditions for disposal using a simple thermodynamic approach. The methodology and running of the program are described together with a worked example.

14200 **(AERE-R—12147) Study of salt transport in a porous medium. The application of NAMMU to HYDROCOIN Level 1 Case 5.** Herbert, A.W.; Jackson, C.P. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.; Department of the Environment, London (UK)). Dec 1986. 30p. H.M. Stationery Office, London, price Pound 5.00.

The results of a study of test case 5 of the international HYDROCOIN project using the finite-element groundwater code NAMMU are presented. This test case proposed to model the groundwater flow over a hypothetical salt dome, with strong density variations due to dissolved salt. The non-linearities arising from the density variation and from the use of a velocity dependent dispersion tensor made the problem very hard. It proved impossible to solve directly, and we had to resort to special techniques including mixed interpolation finite elements and parameter stepping. Starting from a related problem involving a large diffusivity we obtained a series of solutions at successively smaller values of dispersion. Our final solution was to a physically realistic problem very similar to that specified. Further parameter stepping was deemed unnecessarily expensive. Our results were the best obtained by the HYDROCOIN participants, and we have learnt much about problems involving variable density groundwater flows.

14201 **(AERE-R—12219) Objectives of NIREX research in support of post-closure radiological assessments for LLW and ILW disposal.** Hodgkinson, D.P.; Robinson, P.C.; Tasker, P.W.; George, D. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Apr 1986. 12p. (CONF-8606355—). H.M. Stationery Office, London, price Pound 4.00.

From Department of Energy symposium on research objectives to 1990 related to radioactive waste management; Garston, UK (11 Jun 1986).

The paper outlines the objectives of the Nirex RandD programme and the approach that is being followed to assess the safety of disposing of LLW and ILW in geological formations. Compliance with regulatory targets is to be demonstrated using a hierarchy of mathematical models which are validated and calibrated using laboratory and field experiments. An iterative process of measurement and analysis is required to quantify the most important processes controlling the safety of a particular disposal option.

14202 **(AERE-R—12223) Preliminary experimental studies on the chemical and radiation degradation of combustible plutonium contaminated material.** Bradshaw, S.; Gaudie, S.C.; Greenfield, B.F.; Lyon, C.E.; Rees, J.H.; Spindler, M.W.; Wilkins, J.D. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.; Department of the Environment, London (UK)). Oct 1986. 30p. (ILWRP—86/P13). H.M. Stationery Office, London, Price Pound 5.00.

The chemical and radiation degradation of combustible plutonium contaminated material (PCM) in a cement matrix has been investigated. Experimental studies have been carried out to establish the influence of any water soluble chemical and radiation degradation products on the solubility of plutonium at high pHs. The influence of complexing agents (e.g. EDTA, citric acid), which may be present in wastes, on plutonium solubility has been assessed. The extent of sorption on cement in the presence of organic degradation products has been measured.

14203 **(AERE-R—12307) Probabilistic safety assessment in radioactive waste disposal.** Robinson, P.C. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Jul 1987. 57p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750331/JAW.

Probabilistic safety assessment codes are now widely used in radioactive waste disposal assessments. This report gives an overview of the current state of the field. The relationship between the codes and the regulations covering radioactive waste disposal is discussed and the characteristics of current codes is described. The problems of verification and validation are considered.

14204 **(AERE-R—12311) Probabilistic systems assessment codes intercomparison: Level 0.** Robinson, P.C. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Oct 1986. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750892/JAW.

The Nuclear Energy Agency has set up a group of users of Probabilistic Safety Assessment Codes in radioactive waste disposal. We describe the results obtained for the NEA PSAC User Group Intercomparison Level 0. The purpose of this intercomparison is to check the statistical parts of the various codes by using them all on the same simple example. In order to get reliable results we have used one million samples. Results are presented for one thousand and one million samples. The averages calculated with small samples are reasonably accurate even though the maximum possible dose is substantially underestimated.

14205 **(AERE-R—12574) Washing of plutonium contaminated combustible material. Treatment of aqueous effluents and further washing studies.** Ashby, P.J.; Greenfield, B.F.; Sexon, T.; Wilkins, J.D.; Wisbey, S.J. (UKAEA Harwell Lab. Chemistry Div.; Department of the Environment, London (UK)). Aug 1987. 39p. (LETTF—86-P32; PCMRP—87-P13). H.M. Stationery Office, London, price Pound 5.00.

The results of further trials of the washing process for decontamination of combustible plutonium contaminated material (PCM) are described. The trials have covered a wide range of materials and particular emphasis has been placed on establishing the quantities of secondary waste arisings produced. Ferric floc precipitation has been investigated as a treatment method for the aqueous effluents and the plutonium containing fines from the washing process have been treated by incineration.

14206 **(ANS—586-1) Thermal analysis of heat generating waste in deep ocean sediments.** Maynard, M.J.; Green, R.S.; Firmin, G.H. (Associated Nuclear Services, Epsom (UK)). Feb 1986. 127p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750819/JAW.

Time dependent thermal behaviour of sediment surrounding heat generating waste emplaced in the deep ocean floor has been investigated analytically for both the drilled hole and penetrator emplacement options. In both options peak sediment temperature rises of approx. 120°C are calculated, occuring at about 3 years and 8 years from emplacement for the drilled hole and penetrator respectively. Sediment temperatures were found to be sensitive to the waste heat loading and sediment thermal conductivity. The results of the present study reproduced closely the results of earlier studies.

14207 **(ANS—595-1) User's guide to the radionuclide inventory and hazard code INVENT.** Nancarrow, D.J.; Thorne, M.C. (Associated Nuclear Services, Epsom (UK); Department of the Environment, London (UK)). May 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750836/JAW.

This report constitutes the user's guide to the radionuclide inventory and hazard index code INVENT and provides an explanation of the mathematical basis of the code, the database used and operation of the code. INVENT was designed to facilitate the post-closure radiological assessment of land-based repositories for low and intermediate-level wastes. For those radionuclides identified to be of potential significance, it allows the calculation of time-de-

pendent radionuclide activities, hazard indices for both inhalation and ingestion of activity, and photon spectra.

14208 (ANS—595-4) User's guide to the repository intrusion risk evaluation code INTRUDE. Nancarrow, D.J.; Thorne, M.C. (Associated Nuclear Services, Epsom (UK); Department of the Environment, London (UK)). May 1986. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750848/JAW.

The report, commissioned by the Department of the Environment as part of its radioactive waste management research programme, constitutes the user's guide to the repository intrusion risk evaluation code INTRUDE. It provides an explanation of the mathematical basis of the code, the database used and the operation of the code. INTRUDE is designed to facilitate the estimation of individual risks arising from the possibility of intrusion into shallow land burial facilities for radioactive wastes. It considers a comprehensive inventory of up to 65 long-lived radionuclides and produces risk estimates for up to 20 modes of intrusion and up to 50 times of evaluation.

14209 (ANS-R—695-1) Investigation of storage and treatment options for radioactive wastes prepared for sea disposal. Wakerley, M.W.; Woodfine, B.C. (Associated Nuclear Services, Epsom (UK); Department of the Environment, London (UK)). Jul 1986. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750816/JAW.

A sea disposal of 3500 t of packaged waste using a specially converted ship was planned for 1983, but did not take place. The major part of this waste is currently stored at two UKAEA sites. The waste packages were made with the intention that they would be disposed of within about 18 months of packaging. It was not intended that they would be stored for long periods. All wastes are packaged in mild steel drums and the wastes are temporarily stored within buildings. The conditions under which the packages are stored and their present condition are described and possible storage and treatment options are investigated having regard to available disposal routes.

14210 (BMI/ONWI—657-Vol.2) Deposition of Cretaceous and Tertiary sediments in the eastern Mississippi Salt Basin (with emphasis on the Richton Dome Area): Volume 2, Plates. (Earth Technology Corp., Long Beach, CA (USA); Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Aug 1987. Contract AC02-83CH10140;AC02-87CH10290. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002185/JAW.

Regional structure-contour and isochore maps were constructed for selected Cretaceous and Tertiary lithostratigraphic units in the eastern half of the basin. Analysis of the isochore maps suggests that 70 to 80% of the sediment deposited within the basin during the Cretaceous Period was accompanied by subsidence of the continental margin; the remaining 20 to 30% was accompanied by subsidence of the Mississippi Salt Basin. As the continental margin reached isostatic equilibrium during the Tertiary, less sediment was deposited and thus was accompanied by less regional subsidence. Maximum depositional rates occurred during periods of delta building, and minimum rates occurred during periods of shallow marine deposition. Structure-contour and isochore maps were also constructed for a 1400-mi^2 (3500-km^2) area in the vicinity of Richton Dome to illustrate the effects of local salt withdrawal on the sedimentation patterns. This volume contains only maps.

14211 (BMI/ONWI—661) Preliminary interpretations of hydrogeologic data from boreholes and springs in the vicinity of Davis and Lavender Canyons, Utah. Thackston, J.W. (Woodward-Clyde Consultants, San Francisco, CA (USA); Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Sep 1987. Contract AC02-83CH10140. 160p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88002242/JAW.

This information is presented in tabular form and includes station locations, potentiometric levels, permeabilities, transmissibilities, total dissolved solids, depths, locations, data sources, a fracture log of the Gibson Dome No. 1 (GD-1) borehole, and other useful information. Three different ranking scales were used to evaluate available drill-stem test (DST) data. A preliminary detailed hydrogeologic column was prepared using the DST data and GD-1 borehole information. A series of preliminary potentiometric maps was interpreted from these data for the different hydrogeologic units. Preliminary potentiometric surface maps for the Lower Paleozoic Aquifer, Pennsylvanian Aquitard, Permian Aquifer/Aquitard, and Mesozoic (Jurassic) Aquifer were constructed. These maps show a general southwest flow direction in the Lower Paleozoic Aquifer, extremely low permeabilities in the Pennsylvanian, northerly ground-water flow in the Permian, and westward flow direction in the Mesozoic unit. The few data points in the Pennsylvanian tend to indicate that ground water in the upper Paradox Formation may be flowing toward the west and southwest in the area southeast of Six-Shooter Peaks.

14212 (BMI/ONWI—663) Intracrystalline brine inclusion motion for Palo Duro Unit 5 salt from the Mansfield No. 1 borehole in Oldham County, Texas. Krause, W.B.; Brodsky, N.S. (RE/SPEC, Inc., Albuquerque, NM (USA); Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Oct 1987. Contract AC02-83CH10140;AC02-87CH10290. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88002187/JAW.

A microscope equipped with a hot stage was used to monitor intracrystalline migration of natural fluid inclusions in Palo Duro Basin Unit 5 salt from the Mansfield No. 1 borehole in Oldham County, Texas. Steady-state velocities are determined for 65 inclusions between 0.04 mm and 0.82 mm in size subjected to temperature gradients between 200 K/m and 1440 K/m at temperatures of 318°K to 475°K. Inclusion velocity increases with increasing inclusion size, mean salt temperature, and temperature gradient. Two models that predict brine inclusion velocity as a function of temperature, temperature gradient, and inclusion size are used to analyze the data. The models are simplified due to uncertainties in properties that depend on brine chemistry and temperature, such as the equilibrium salt concentration of the brine. These simplified models are then fitted to the data and the fitted parameters are used to estimate the threshold temperature gradient below which inclusions do not migrate. The threshold temperature gradients determined in this study are in reasonable agreement with other values reported in the literature. Since values of the fitted parameters depend on the chemical composition of the brine, it is necessary to determine the model parameters and threshold temperature gradient for each repository site. 14 refs., 17 figs., 6 tabs.

14213 (BMI/ONWI—666) Measured data from the Avery Island, Louisiana, heating corejacking tests. Stickney, R.G. (RE/SPEC, Inc., Rapid City, SD (USA)). Sep 1987. Contract AC02-87CH10290. 149p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88002813/JAW.

This report presents the unanalyzed data obtained from a series of heated corejacking tests conducted in the Avery Island salt mine. These tests were a part of a field testing program at Avery Island to characterize the thermomechanical response of domal salt when subjected to conditions similar to those expected in a high-level nuclear waste repository. The primary objective of the corejacking tests was to supply field data for validation of the numerical methods used to predict the creep behavior of salt. Two previous series of corejacking tests provided data for the ambient temperature test condition. This series of tests produced results for heated test conditions. The purpose of this report is to transmit the data from the heated corejacking tests to the scientific community. Rigorous analysis or interpretation of the data is considered beyond the scope of this data report. 3 refs., 24 figs., 1 tab.

14214 (BNL—52085) Assumptions, uncertainties, and limitations in the predictive capabilities of models for sensitization in 304 stainless steels. Schweitzer, D.G.; Sastre, C. (Brookhaven National Lab., Upton, NY (USA)). Jun 1987. Contract AC02-76CH00016. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002818/JAW.

A review of literature on sensitization in 304 stainless steels has been made from what we believe would be the regulatory framework evaluating the claim that there is reasonable assurance that predicts the absence of sensitization for the times (300 to 1000

years) and temperatures (below about 200°C) associated with a high-level waste (HLW) repository at Yucca Mountain. We conclude that such a claim would be indefensible. 17 refs.

14215 **(CEA-CONF—9026) Sensitivity studies to hydrological modelisation in granite formation: two examples.** Durin, M.; Stietel, A.; Astruc, R.; Peres, J.M.; Van Kote, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Apr 1987. 3p. (CONF-870450—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751539/JAW.

From Symposium on verification and validation of geosphere performance assessment models; Stockholm, Sweden (7 Apr 1987).

Published in summary form only.

14216 **(CEA-CONF—9147) Melodie: A global risk assessment model for radioactive waste repositories.** Lewi, J.; Assouline, M.; Bareau, J.; Raimbault, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Mar 1987. 35p. (CEA-DAS—936; CONF-861246—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751565/JAW.

From Workshop on numerical modeling for radioactive waste repositories; Madrid, Spain (10 Dec 1986).

The Institute of Protection and Nuclear Safety (IPSN), which is part of the French Atomic Energy Commission (C.E.A.) develops since 1984 in collaboration with different groups inside and outside the C.E.A. a computer model for risk assesment of nuclear waste repositories in deep geological formations. The main characteristics of the submodels, the data processing structure and some examples of applications are presented.

14217 **(CEA-CONF—9153) Results from the Metis code participation to the Hydrocoin exercise.** Raimbault, P.; Goblet, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Apr 1987. 19p. (CEA-DAS—353; CONF-870450—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751567/JAW.

From Symposium on verification and validation of geosphere performance assessment models; Stockholm, Sweden (7 Apr 1987).

The METIS code, developed at the ENSMP is a 2D finite element radionuclide transport and groundwater flow model based on the hypothesis of an equivalent porous medium with an explicit description of the main fractures. It is integrated in the global risk assessment code MELODIE for nuclear waste repositories in geological formations. The participation of the METIS code to the HYDROCOIN exercise is of prime importance for its development and its incorporation in the performance assessment procedure in France. Results from HYDROCOIN cases show that the code can handle correctly fractured media, high permeability contrast formations and buoyancy effects. A 3D version of the code has been developed for carrying comparisons of field experiments and groundwater flow models in HYDROCOIN level 2. In order to carry out the exercise, several pre and post-processing programs were developed and integrated in a conversational module. They include: contour plots, velocity field representations, interpolations, particule tracking routines and uncertainty and sensitivity analysis modules.

14218 **(CNEA-NT—8/81) Radiological impact of radioactive waste management.** Beninson, D.J.; Migliori de Beninson, A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Proteccion Radiologica y Seguridad). 1985. 84p. (In Spanish). (CNEA-REPO—1). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700581/JAW.

Reprint of CNEA-NT–8/81. Argentine contribution to INFCE (INFCE/DEP/WG 7/18).

The radiological impacts from management of wastes from the nuclear fuel cycle have been estimated for several alternative fuel cycle strategies. The impacts are expressed as collective effective dose equivalent commitments. Mill tailings make an important contribution, which depends on the uranium requirements for each reference fuel cycle, being the largest for once-through cycles. Disposal of high level waste or spent fuel is also an important contribution, usually larger for once-through cycle where the entire actinide inventory is disposed off. Although at present conversion and enrichment tailing are not considered wastes, they have assumed to be wastes in the reference cycle. In this case, their relative contribution is significant for fuel cycles using enriched uranium. The totals for waste management and disposal are of the same order of magnitude as the collective dose commitments from occupational and public exposures arising from the operation of the nuclear fuel cycle installations. The incomplete collective dose commitments from waste management and disposal assessed by integrating the collective dose rate over a fixed period of time (usually selected as 500 years), at time when the integral is maximum, are also comparable with the corresponding quantity arising from the operation of the fuel cycle installations. The maximum per caput doses predicted for the far future are small, usually a small fraction of the relevant dose limits. The maximun future doses in the critical groups in the vicinity of the repositories will be very low, of about a few percents of that experienced from the exposure to natural radiation sources. (M.E.L.).

14219 **(CNEA-NT—23/85) Temporal evolution of a granitic rock under thermal loads generated by fission products.** Ventura, M.A.; Ferreri, J.C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Proteccion Radiologica y Seguridad). 1985. 39p. (In Spanish). (CNEA-REPO—3). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700582/JAW.

The thermal time history of a granitic mass under thermal loads, generated by the terminal subproducts arising from the Argentine nuclear programme is analyzed. This rock will be the final repository of those subproducts. The analysis is based on the consideration of a representative unit cell of the rock's centre using the Heating 5 programme. A preliminary analysis is made in order to obtain criteria with respect to the accuracy of the problem. Temporal evolution curves of the temperature on zones of interest of the unit cell considered are shown. Under the thermal loads considered, 500W by container, a maximum temperature of 55 deg C at the wall of the orifice subproducts' deposit is obtained. (Author).

14220 **(CNEA-NT—24/85) Temporal evolution of a granitic rock under thermal loads generated by fission products. Parametric study.** Ventura, M.A.; Ferreri, J.C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Proteccion Radiologica y Seguridad). 1985. 51p. (In Spanish). (CNEA-REPO—4). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700583/JAW.

A parametric study of the thermal history of a granitic mass under thermal loads originating in terminal subproducts of the fuel cycle is performed. Variations of the conductivity and density of the rock and the unit cell dimensions are considered. In this way it was tried to delimit (for short time intervals of the order of 100 years) the influence of possible uncertainties in the rock's knowledge on the results of interest for the engineering design. In the reasonable situations considered, the maximum temperature in the rock did not rise over 80 deg C.

14221 **(CNEA-NT—42/85) Diffusion of heat from a finite, rectangular, plane heat source.** Ferreri, J.C.; Caballero, C.H. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Proteccion Radiologica y Seguridad). 1985. 16p. (In Spanish). (CNEA-REPO—13). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700585/JAW.

Non-dimensional results for the temperature field originating in a rectangular, finite, plane heat source with infinitesimal thickness are introduced. The source decays in time, zero decay being a particular case. Results are useful for obtaining an aproximation of the maximum temperature of a system holding an internal heat source. The range selected for the parameters is specially useful in the case of a nuclear waste repository. The application to the case of mass diffussion arises from analogy. (Author).

14222 (CNEA-NT—44/85) Numerical aspects of the modelling of the local effects of a high level waste repository. Ferreri, J.C.; Ventura, M.A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Proteccion Radiologica y Seguridad). 1985. 15p. (In Spanish). (CNEA-REPO—16). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700586/JAW.

The numerical approximations adapted for the development of the computational models for the prediction of the effects of the emplacement of a high level waste repository are reviewed. The problems considered include: the thermal history of the rocky mass constituting the burial media, the flow of underground water and the associated migration of radionuclides in the same media. Results associated with verification of the implemented codes are presented. Their limitations and advantages are discussed.

14223 (CNEA-NT—48/85) Conceptual frame for the development of models for the prediction of the local effects of a high level waste repository. Palacios, E.; Ferreri, J.C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Proteccion Radiologica y Seguridad). 1985. 7p. (In Spanish). (CNEA-REPO—15). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700587/JAW.

Safety analyses associated with the elimination of radioactive wastes in rock masses assume, in all cases, the existance of wastes which will corrode the waste canisters producing the liberation of radionuclides in the rocky and their ultimate migration towards the biosphere. A conceptual discussion is presented which allows the specification to be met by the models for the prediction of the effects of the emplacement of a high level waste repository located at a depth of 500 m in a granitic rock. Furthermore, the radionuclides giving the largest contribution to the radiological impact are identified.

14224 (CONF-860317—62) Boric Acid Reclamation System (BARS). Kniazewycz, B.G.; Markind, J. (KLM Technologies, Inc., Walnut Creek, CA (USA)). Mar 1986. Contract AC03-84ER80145. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88002496/JAW.

From Waste management '86; Tucson, AZ, USA (2 Mar 1986).

KLM Technologies' personnel have identified a Boric Acid Reclamation System (BARS) utilizing reverse osmosis and ultrafiltration to produce a recyclable grade of otherwise waste boric acid at PWRs, thus reducing a major source of low-level radwaste. The design of a prototype BARS as a compact volume reduction system was the result of KLM's Phase 1 Program, and based upon a preliminary feasibility program, which assessed the applicability of membrane technology to refurbish and recycle waste boric acid from floor and equipment drain streams. The analysis of the overall program indicated a substantial savings regarding off-site disposal costs. Today's economic scenario indicates that optimization of volume reduction operation procedures could significantly reduce waste management costs, especially where burial penalties have become more severe. As a reaction to the economic burden imposed by final disposal, many nuclear plants are currently modifying their design and operating philosophies concerning liquid radwaste processing systems to meet stricter environmental regulations, and to derive potential economic benefits by reducing the ever-increasing volumes of wastes that are produced. To effect these changes, innovative practices in waste management and more efficient processing technologies are being successfully implemented.

14225 (CONF-870306—69) KLM's Boric Acid Reclamation System (BARS): An update. Schuelke, D.; Kniazewycz, B.G.; Markind, J.; Brossart, M.A.; Choi, R.C. (KLM Technologies, Inc., Walnut Creek, CA (USA); Northern States Power Co., Welch, MN (USA)). Feb 1987. Contract AC03-84ER80145. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002497/JAW.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

KLM Technologies has implemented its Department of Energy Phase II Small Business Innovative Research (SBIR) demonstration program for a radioactive waste Boric Acid Reclamation System (BARS). Preliminary performance indicates enhanced treatment by the BARS technique over state of the art process methods for selective removal of silica and other impurities from borated water matrices. At optimal system recovery of 96 to 97%, BARS removes nominal levels of boric acid while achieving significant rejection for soluble silica and selective radioisotopes. This is indicative of superior performance compared to existing data governing standard boric acid process treatment in the presence of silica and other contaminants. Conventional technologies have also proven to be relatively expensive, utilizing costly chemically treated disposable resins for primary waste removal. The overall BARS program indicates substantial savings regarding off-site disposal costs based on reduced waste generation. Optimization of the BARS technology could have potential impact on conventional process technologies that are essentially non-selective in removal capacities. 2 figs.

14226 (CONF-871187—1) Charging for waste motivates generators to optimize waste control at the source. Berry, J.B.; Homan, F.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A03. Order Number DE88002528/JAW.

From 8. symposium on hazardous and industrial solid waste testing and disposal; Clearwater, FL, USA (12 Nov 1987).

The Oak Ridge National Laboratory, a multipurpose research and development facility, has implemented a program to include the cost of waste management in product costs. Steps include planning and evaluation tailored to institutional constraints, methods for conflict resolution, and administrative structure that places responsibility for optimizing waste control at the source on waste generators. Changes in waste disposal practices required to meet regulatory requirements increase the cost of waste management and are reflected in the rate structure. Rate structure and changes in waste disposal practices are compared. Rates are dependent on the type of waste handled, compliance with waste acceptance criteria, processing steps required for treatment, and disposal requirements. 2 refs., 1 fig., 1 tab.

14227 (CUED-D-SOILS-TR—167) List of abbreviations used in nuclear waste management. Lau, F.S. (Cambridge Univ. (UK). Dept. of Engineering). 1986. 75p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks., LS23 7BQ.

The paper contains a list of abbreviations used in nuclear waste management, in alphabetical order. The list was prepared by the Engineering Department, University of Cambridge, United Kindom. (U.K.).

14228 (DM-TR—8) Development of TIME 2 code. Progress review. (Dames and Moore International, Twickenham (UK)). Feb 1986. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750820/JAW.

The paper reviews the progress on the development of a computer model TIME 2, for modelling the long term evolution of shallow burial site environments for low- and intermediate-level radioactive waste disposal. The subject is discussed under the five topic headings: 1) background studies, including geomorphology, climate, human-induced effects, and seismicity, 2) development of the TIME 2 code, 3) verification and testing, 4) documentation, and, 5) role of TIME 2 in radiological risk assessment. (U.K.).

14229 (DOE/CH/46656—07) Subsurface quality assurance practices. (Morrison-Knudsen Engineers, Inc., San Francisco, CA (USA); Fluor Technology, Inc., Irvine, CA (USA)). Aug 1987. Contract AC02-83WM46656;AC02-87CH10290;AC02-83CH10140. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002492/JAW.

This report addresses only the concept of applying Nuclear Quality Assurance (NQA) practices to repository shaft and subsurface design and construction; how NQA will be applied; and the level of detail required in the documentation for construction of a shaft and subsurface repository in contrast to the level of detail required in the documentation for construction of a traditional mine. This study determined that NQA practices are viable, attainable, as well as required. The study identified the appropriate NQA criteria

and the repository's major structures, systems, items, and activities to which the criteria are applicable. A QA plan, for design and construction, and a list of documentation, for construction, are presented. 7 refs., 1 fig., 18 tabs.

14230 **(DOE/RW—0047-Vol.1-Rev.) Analysis of the total system life cycle cost for the Civilian Radioactive Waste Management Program: Volume 1, The analysis and its results.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jun 1987. 143p. Civilian Radioactive Waste Management, USDOE RW-40, Washington, DC 20585; GPO Dep. Order Number TI88004363/JAW.

This report provides cost estimates for the fifth evaluation of the adequacy of the fee and is consistent with the program strategy and plans. The total-system cost for the reference cases in the improved-performance system is estimated at $32.1 to $38.2 billion (expressed in constant 1986 dollars) over the entire life of the system...or $1.5 to $1.6 billion more than that of the authorized system (i.e., the system without an MRS facility). The current estimate of the total-system cost for the reference cases in the improved-performance system is $3.8 to $5.4 billion higher than the estimate for the same system in the 1986 TSLCC analysis. In the case with the maximum increase, nearly all of the higher cost is due to a $5.2-billion increase in the costs of development and evaluation (D and E); all other system costs are essentially unchanged. The cost difference between the improved-performance system and the authorized system is smaller than the difference estimated in last year's TSLCC analysis. Volume 2 presents the detailed results for the 1987 analysis of the total-system life cycle cost (TSLCC). It consists of four sections: Section A presents the yearly flows of waste between waste-management facilities for the 12 aggregate logistics cases that were studied; Section B presents the annual total-system costs for each of the 30 TSLCC cases by major cost category; Section C presents the annual costs for the disposal of 16,000 canisters of defense high-level waste (DHLW) by major cost category for each of the 30 TSLCC cases; and Section D presents a summary of the cost-allocation factors that were calculated to determine the defense waste share of the total-system costs.

14231 **(DOE/RW—0047-Vol.2-Rev.) Analysis of the total system life cycle cost for the Civilian Radioactive Waste Management Program: Volume 2, Supporting information.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jun 1987. 147p. Civilian Radioactive Waste Management, USDOE RW-40, Washington, DC 20585; GPO Dep. Order Number TI88004362/JAW.

This report provides cost estimates for the fifth evaluation of the adequacy of the fee and is consistent with the program strategy and plans. The total-system cost for the reference cases in the improved-performance system is estimated at $32.1 to $38.2 billion (expressed in constant 1986 collars) over the entire life of the system, or $1.5 to $1.6 billion more than that of the authorized system (i.e., the system without an MRS facility). The current estimate of the total-system cost for the reference cases in the improved-performance system is $3.8 to $5.4 billion higher than the estimate for the same system in the 1986 TSLCC analysis. In the case with the maximum increase, nearly all of the higher cost is due to a $5.2-billion increase in the costs of development and evaluation (D and E); all other system costs are essentially unchanged. The cost difference between the improved-performance system and the authorized system is smaller than the difference estimated in last year's TSLCC analysis. Volume 2 presents the detailed results for the 1987 analysis of the total-system life cycle cost (TSLCC). It consists of four sections: Section A presents the yearly flows of waste between waste-management facilities for the 12 aggregate logistics cases that were studied; Section B presents the annual total-system costs for each of the 30 TSLCC cases by major cost category; Section C presents the annual costs for the disposal of 16,000 canisters of defense high-level waste (DHLW) by major cost category for each of the 30 TSLCC cases; and Section D presents a summary of the cost-allocation factors that were calculated to determine the defense waste share of the total-system costs.

14232 **(DOE/RW—0166) Additional information on monitored retrievable storage.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Nov 1987. 113p. Office of Civilian Radioactive Waste Management, USDOE RW-40, Washington, DC 20585; GPO Dep. Order Number TI88003684/JAW.

This report examines various ways in which the transportation and the storage of spent fuel can be managed without an MRS facility and then compares these alternative waste-management systems with a system containing an MRS facility; the comparison is made in terms of system development, operations, cost, risk, and feasibility. It also discusses the costs not quantified in the proposal. It summarizes the views of several US electric utilities and representative groups on both the MRS facility and various at-reactor options that have been proposed for spent-fuel management. 26 refs., 2 figs., 21 tabs.

14233 **(DP—85-125-1/2) Waste Management Program: Technical progress report, January-June 1985.** (BE, Inc., Barnwell, SC (USA)). Dec 1987. Contract AC09-76SR00001. 32p. (BEI/SRL—8655-1/85). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005076/JAW.

This report provides information on operations and development programs relating to the management of radioactive wastes at the Savannah River Plant. Information on environmental and safety assessments, waste form development, and process and equipment development are reported for long-term waste management. 35 refs., 12 figs., 8 tabs.

14234 **(DP—85-125-3/4) Waste Management Program: Technical progress report, July-December 1985.** (BE, Inc., Barnwell, SC (USA)). Dec 1987. Contract AC09-76SR00001. 43p. (BEI/SRL—8655-2/85). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005077/JAW.

This report provides information on operations and development programs relating to the management of radioactive wastes at the Savannah River Plant. Information on environmental and safety assessments, waste form development, and process and equipment development are reported for long-term waste management. 13 refs., 20 figs., 16 tabs.

14235 **(DP-MS—87-5) Overview of Savannah River Plant waste management operations.** Haywood, J.E.; Killian, T.H. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 5p. (CONF-870306—68). NTIS, PC A02. Order Number DE88002439/JAW.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Du Pont Savannah River Plant (SRP) Waste Management Program is committed to the safe handling, storage, and disposal of wastes that result from the production of special nuclear materials for the US Department of Energy (US DOE). High-level radioactive liquid waste is stored in underground carbon steel tanks with double containment, and the volume is reduced by evaporation. An effluent treatment facility is being constructed to treat low-level liquid hazardous and radioactive waste. Solid low-level waste operations have been improved through the use of engineered low-level trenches, and transuranic waste handling procedures were modified in 1974 to meet new DOE criteria requiring 20-year retrievable storage. An improved disposal technique, Greater Confinement Disposal, is being demonstrated for intermediate-level waste. Nonradioactive hazardous waste is stored on site in RCRA interim status storage buildings. 5 figs.

14236 **(DP-MS—87-70) Leaching Tc-99 from SRP glass in simulated tuff and salt groundwaters.** Bibler, N.E.; Jurgensen, A.R. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 9p. (CONF-871124—52). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004740/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Results of leach tests with Tc-99 doped SRP borosilicate waste glass are presented. The glass was prepared by melting a

mixture of SRP 165 powdered frit doped with a carrier free solution of Tc-99 at 1150°C. Dissolution of portions of the resulting glass indicated that the Tc-99 was distributed homogeneously throughout the glass. Static leach tests up to 90 days were performed at 90°C in J-13 tuff groundwater or WIPP brine A at a SA/V of $100m^{-1}$. Normalized mass losses were calculated for Tc-99 as well as all the major elements in the glass. Results indicated that under ambient oxidizing conditions Tc-99 leached no faster than the glass-forming elements of the glass. In J-13 water, Tc-99 leached congruently with B. In WIPP brine A, it leached congruently with Si. Leach rates for Li were higher in both groundwaters, probably due to a contribution from an ion exchange mechanism. Leach tests were performed under reducing conditions in J-13 water by adding Zn/Hg amalgam to the leachate. In these tests the pH increased significantly, probably because of the reaction of the amalgam with the water. In a 21-day test, the pH increased to 13 and leach rates for the glass were very high. Even though there was signifcant dissolution of the glass, the normalized mass loss based on Tc-99 was only $0.02g/m^3$. This result and the fact that reducing conditions at normal pH values do not significantly affect the dissolution of the glass, indicate that the low concentrations for Tc-99 obtained under reducing conditions are due to is solubility and not due to an increased durability of the glass. 14 refs., 2 figs., 5 tabs.

14237 **(ENEA-RT-COMB—87-7) The R & D activities carried out in Ispra, according to a cooperation between ENEA COMB and JRC-Ispra in the field of radioactive waste management.** Nannicini, R.; Dworschak, H.; Daniele, F. (ENEA, Rome (Italy)). Jul 1987. 20 p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751903/JAW.

The R & D activities carried out in Ispra since 1984, under the ENEA-COMB/CCR-ISPRA collaboration contract, concerned HLW vitrification under working conditions at the ESTER minipilot plant. The paper discusses the decommissioning of this plant and the characterization of the active glasses produced. Finally, the paper reports on the start-up of the PETRA plant (design and construction), which is more complete than the ESTER one.

14238 **(EUR—10671) CEC natural analogue working group.** Come, B.; Chapman, N.A. (eds.). (Commission of the European Communities, Luxembourg). 1986. 296p. (CONF-8606319—). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW.

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

The second meeting of the CEC Natural Analogue Working Group took place on June 17-19, 1986, hosted by the Swiss NAGRA in Interlaken (CH). A review of recent progress in natural analogue programmes was carried out, and complemented by detailed discussions about geomicrobiology, archaeological analogues, natural colloids, and use of analogues to increase confidence in safety assessments for radioactive waste disposal. A statement drafted by the Group, and the presentations made, are put together in this report.

14239 (EUR—10671, pp 75-92) **Modelling radionuclide transport at the Koongarra uranium deposit.** Lever, D.A. 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

A preliminary theoretical interpretation of data on the concentration of uranium and the distribution between various isotopes at the Koongarra uranium deposit in Northern Australia is presented using a simple transport model. The results are consistent with / sup 234/U migrating more slowly than /sup 238/U as a result of α-recoil. Two methods of estimating the migration time have been developed: one based on laboratory and field values of the uranium distribution coefficient and numerical estimates of the groundwater velocity, and the other based on the spatial gradient of /sup 238/U and the disequilibria between /sup 234/U and /sup 238/U or between /sup 230/Th and /sup 234/U in drill core samples. We conclude that a consistent picture is being developed if there has been an elapsed time of 1-3x10/sup 6/ yrs since the uranium was mobilized. A preliminary analysis of the distribution of lead isotopes is also presented.

14240 (EUR—10671, pp 93-100) **Cigar lake project: a U-deposit natural analog.** Sargent, F.P.; Cramer, J.J. (Atomic Energy of Canada Limited, Pinawa, Manitoba). 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

In the Canadian Nuclear Fuel Waste management Program (CNFWP), AECL is responsible for coordinating and managing the research and development program for the immobilization and disposal of fuel wastes. The Cigar Lake deposit is particularly valuable to conduct a comprehensive analog study because of the present status of development of the deposit. In addition to exploration data, extensive mineralogical and geochemical information already exist and is being collected by the exploration and mining companies. Environmental impact studies have included investigations of the hydrology and ground water chemistry, as well as many aspects and processes at surface and in the glacial overburden. The apparent lack of mobility of uranium for over a billion years is presumed to be due to the reducing nature of groundwaters. The redox couples that control the Eh are being investigated further along with the role of bacteriological activity and colloids.

14241 (EUR—10671, pp 101-113) **Marysvale natural analogue study: results to date.** Shea, M.E. 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

The Marysvale Natural Analogue Study is being conducted by the Office of Crystalline Repository Development for the U.S. Department of Energy. The major focus of this study is the elucidation of the mass transport of nuclides in an inactive hydrothermal system within granitic rock. Of particular concern are: (1) radionuclide migration by diffusion and/or fluid transport; (2) effects of fractures on the movement of groundwater and radionuclides; (3) absorption characteristics of the host rock and its constituent mineral phases; (4) possible complexing of radionuclides with groundwater and rock components; (5) precipitation/solubility of these various ligands; and (6) the effect upon rock strength and permeability by the interaction of heat, groundwater, and radionuclides. The objective is to quantify, or even qualify, these important factors which would be extremely helpful in selecting a suitable repository site that would avoid adverse conditions and/or take advantage of favorable ones.

14242 (EUR—10671, pp 198-224) **Geochemical modelling of copper degradation.** Jensen, B.S.; Jensen, H. (Riso National Laboratory, Denmark). 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

It is generally accepted that the container for HLW-glass shall be designed to resist corrosion for a long time span such that it effectively contributes to the barriers against the transport of waste components to the biosphere. Among the more sophisticated alloys which are considered for this use, the Swedish concept points to the use of copper as container material. Among the arguments used in the public is the good everyday experience most people have of the stability of coppertubing used in the inhouse water-supply. Another argument in supporting the choice of copper as a good candidate for container material is its wide occurrence as metallic copper in nature which indicates that at least under favourable conditions it will remain stable. Naturally these arguments have been supported by both experimental and theoretical work and here a few of the theoretical aspects of copper stability based on thermodynamic considerations, are presented.

14243 (EUR—10671, pp 173-190) **Case history on long-term effectiveness of clay sealant.** Lee, C.F. (Atomic Energy of Canada Limited, Pinawa, Manitoba). 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

This report documents a case history in which a cadaver and the associated burial objects were found to be well-preserved after more than 2100 years of burial in Southern China. The preservation was attributed to the presence of a 60-300 cm thick kaolin or white clay layer around the tomb, which acted effectively as a barrier to moisture and air percolation. The degree of preservation in other tombs of similar age in the same area apparently depended on the mineralogy and thickness of the clay sealants used. The implication of this case history to nuclear fuel waste disposal is discussed.

14244 (EUR—10671, pp 227-260) **Identification and Measurement of Colloids in Groundwater.** Ivanovich, M.; Hardy, C.J. (Atomic Energy Research Establishment, Harwell, UK; Australian Atomic Energy Commission, Sutherland). 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

Radionuclide migration in the terrestrial environment is at present the subject of intense study because of the requirements for the disposal of radioactive wastes. Although considerable progress has been achieved in understanding the migration characteristics of solute species, little work has been carried out on the nature or mobility of natural colloids of the relevant species. The reason for this apparent lack of effort and/or progress is the difficulty in sampling and characterising water-borne particles. The object of this paper is to outline a series of techniques for identifications and measurement of colloids in groundwaters. This is achieved by outlining natural colloid characteristics in terms of their physical, chemical and biological properties; discussing methods for sampling natural colloids; presenting methods for measurement of colloid parameters; and finally discussing work carried out to dale and future requirements.

14245 (EUR—10671, pp 261-278) **Colloid generation and migration of actinides in natural aquifer system.** Kim, J.I. (Institut fuer Radiochemie, Muenchen, Germany, F.R.). 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

The paper describes the actinide colloid generation in natural aquatic system and its impact on the migration of actinides. The first part deals with the characterization of colloids: kind of colloids, size distribution and chemical composition. The second part illustrates generation phenomena of different colloids, i.e. realcolloids and pseudocolloids. In the last part geochemical interactions of colloids are discussed in connection with the dissolution and sorption processes of actinides in natural aquifer systems.

14246 (EUR—10671, pp 114-118) **Pocos de Caldas analogue project.** Smellie, J. 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

The first year of the Pocos de Caldas analogue project comprises a Pilot and a feasibility study. The Pilot study involved a preliminary evaluation of the Osamu Utsumi uranium mine site. This involved: the drilling of a test borehole at the uranium mine in the vicinity of the proposed investigation site; the assessment of the analytical facilities and sample capacity of the participating Brazilian laboratories. The feasibility study will include a major part of the drilling, sampling for hydrochemical and colloid studies, and sampling for mineralogical and geochemical characterization. As colloidal studies form an important part of the Pocos de Caldas investigations, it is considered important that the deep exploratory hole, scheduled for morro do Ferro at the beginning of the second year programme, should be included as part of the feasibility study.

14247 (EUR—10671, pp 135-137) **Highly alkaline groundwaters in Oman. Geomicrobiological and chemical speciation studies of a natural analogue of cement pore waters.** Chapman, N.A. (British Geological Survey, Keyworth, UK). 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

14248 (EUR—10671, pp 7-15) **Some uses of natural analogues for safety analysis.** Neretnieks, I. (Royal Institute of Technology Stockholm, Sweden). 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

14249 (EUR—10671, pp 19-24) **Natural analogue studies in Britain, work in progress, June 1986.** Chapman, N.A. (British Geological Survey, Keyworth, UK). 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

14250 (EUR—10671, pp 191-197) **Investigations on old bronze cannons.** Neretnieks, I.; Hallberg, R. 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

The burnt-out nuclear fuel is transported from the Swedish nuclear power stations for intermediate deposit to the used fuel storage plant CLAB outside of Oskarshamn. At CLAB the fuel is kept in water tanks for 30-40 years. From CLAB the fuel shall be transported for final deposit somewhere in Sweden. The aim of final deposit is to prevent radioactive substance from the used fuel from leaking out in such amounts harmful to the environment or human beings. Practically this means that the used fuel has to be isolated for a very long period of time. To enable this final deposit, a series of barriers between the dangerous goods and the surface of the earth are created. In the so called KBS 3-report the method for final deposit has been suggested. It is based on a number of fuel elements put into a copper capsule. The capsule is closed and put into the bedrock 500 m down in the earth. There it is put in a drilling hole in a tunnel and sealed with a special type of clay bentonit. The clay prevents ground water from moving around the copper capsule. Two of the most important barriers are the copper capsule and the clay according to this thesis. This is the reason why the copper-cannon from the Man of War KRONAN give scientists an excellent long-term testing opportunity as to how deposits according to KBS 3 can work.

14251 (EUR—10671, pp 119-131) **Analogue studies at the French Atomic Energy Commission (CEA).** Petit, J.C. (CEA CEN Fontenay-aux-Roses, 92, France. IRDI, DRDD). 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

The various research activities of the French Atomic Energy Commission in the analogue study field are presented. Most of them are conducted in collaboration with major research organisations both French and international. The scientific community has been associated to these programmes at different steps of their realisation. This brief description illustrates the great diversity and complementarity of actions conducted by CEA for better understanding, through the study of natural analogues, the basic processes that will rule the long term behavior of radwaste materials in a repository and hence contributing to hopefully guaranty disposal safety.

14252 (EUR—10671, pp 25-26) **Present developments of CEC activities in the field of natural analogues.** Come, B. (CEC, Brussels, Belgium). 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

14253 (EUR—10671, pp 27-73) **Radionuclide migration around uranium ore bodies - progress report on the Alligator rivers analogue project and proposals for future work.** Hardy, C.J. (Australian Atomic Energy Commission, Sutherland). 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

The Australian Atomic Energy Commission has extensively evaluated uranium ore bodies in the Alligator Rivers Province of the Northern Territory of Australia as analogues of radioactive waste repositories. The objective has been to assist in the long-term prediction of the rate of transport of radionuclides through the geosphere. The research work was carried out by the AAEC in its laboratories at Lucas Heights and with extensive field trips in the Alligator Rivers Province, particularly at the uranium deposits at Ranger, Jabiluka, Nabarlek, and Koongarra. The results of the work over the last five years are briefly reviewed in this paper with emphasis on those obtained since the last review presented to the Natural Analogue Working Group in 1985. The results, their preliminary interpretation and their significance to the modelling and prediction of radionuclide transport, are discussed under the five main headings: Distribution of Uranium and Thorium Series Nuclides in Selected Uranium Deposits; The Role of Groundwater Colloids in the Transport of Radionuclides; The Study of Selected Fission Products; The Study of Transuranium Nuclides; and Application and Verification of Modelling Codes for the Transport of Radionuclides.

14254 (EUR—10671, pp 138-152) **Bacteria in ancient sediments.** Izzo, G. (ENEA, Rome, Italy). 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

In order to ascertain the role of biological activity in ancient sediments, two microbiological studies were carried out. The first was on pleistocenic clay sediments on land, the second on deep oceanic sediments. In the present paper by direct counting the samples is demonstrated the presence of bacteria in a range of 10/sup 5/ to 10/sup 7/. Further studies must be carried out to ascertain the activities by in situ incubation methods.

14255 (EUR—10671, pp 153-159) **Natural analogue support for geomicrobiological modelling.** McKinley, I.G.; Grogan, H.A. 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

In this note, the various approaches used to construct quantitative models of the consequences of microbial activity in a nuclear waste repository are discussed. Parameters and processes of major significance in such models are identified for particular repository types and, from this basis, studies of natural systems (analogues) which could be useful are suggested.

14256 (EUR—10671, pp 165-171) **Archaeological concretes as analogues.** Steadman, J.A. 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751583/JAW. (CONF-8606319—).

From 2. NAWG meeting of the C.E.C.; Interlaken, Switzerland (16 Jun 1986).

Archaeological concretes may be used as analogues of the long-term behaviour of concrete components of a radioactive waste repository. This paper discusses the general limitations on their validity as analogues, and the specific processes of concrete degradation currently being studied in the UK for which they might provide analogues; and it reports on relevant past research and progress in current research at BRE, and on current DoE funded extramural studies by Taylor Woodrow Construction and UKAEA, in this field.

14257 (EUR—10672) **Simulation of water transport in heated rock salt.** Schlich, M. (Commission of the European Communities, Luxembourg). [1988]. 273p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780046/JAW.

This final report contains the results of computer simulation studies on water transport in German rock salt. Based on Jockwer's experimental investigations on water content and water liberation, the object of this work was to select a water transport model that matches the water inflow which was measured in some heater experiments in the Asse salt mine. The main result is that an evaporation model with Knudsen type vapour transport combined with fluid transport by thermal expansion of the adsorbed water layers in the non-evaporated zone showed the best agreement with experimental evidence. An extrapolatory calculation for a borehole in a high-level waste repository showed that the water vapour inflow during the time of convergence of the initial gap between canister and borehole will not exceed 200 g per meter.

14258 (EUR—10892) **Study of cladding hull fixation by low water content ceramic cements.** Frotscher, H.; Graebner, H.; Kapulla, H.; Vejmelka, P. (Commission of the European Communities, Luxembourg). 1986. 105p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751598/JAW.

The investigations of the suitability using portland cement free ceramic cements for the fixation of cladding hulls were started with laboratory experiments. The material chosen exhibits the lowest water content by a sufficient compressive strength of the cured product. To produce void free waste forms (hulls + matrix) mixtures with a water content of 12 weight % are suitable. The investigations with radioactive laboratory samples have shown the practicability of the dehydration of Zry-ceramic samples at temperatures of 100 to 150/sup 0/C. In this case, a maximum of 0.06% of the inital activity - mainly as HTO - will be released. The thermal release in argon carrier gas at different temperatures was in relative good agreement with measurements with hydraulic and naked KWO-hulls. The yearly release rates were found in the range of 10/sup -5/ to 10/sup -6/ Ci/Ci. year. The leaching of tritium-, actinides- and fission products at 20/sup 0/C and 90/sup 0/C with H/sub 2/0 and carnalit brine have shown no advantages of ceramic matrix compared with portland cement. The drying of the inactive waste form requires a dry air temperature of 235/sup 0/C. The thermal decomposition of Na-acetate, which is contained in small amounts in the mixture, begins at 175/sup 0/C. A calorimeter was developed for the determination of the power of nuclear heat sources in radioactive waste and tested in hot cells. Compared to KORIGEN-calculations the measured values are 20 to 30% lower. The experimental facility MEGA was designed to determine the activity of the volatile fission products and hydrogen concentration.

14259 (EUR—10893) **Separation of transuranium elements and fission products from medium activity aqueous liquid wastes.** Gompper, K.; Kunze, S.; Eden, G.; Loesch, G.; Zemski, C. (Commission of the European Communities, Luxembourg). 1986. 153p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751599/JAW.

In the course of work performed between January 1981 and June 1985 on the separation of TRU elements and fission products three liquid alpha containing waste streams were treated: - medium level waste solutions, - waste solutions from the acid digestion of burnable alpha containing solid residues, - waste solutions from mixed oxide fuel element fabrication. The method of separation was initially developed and optimized with simulating substances. Subesequently it was tested with real waste solutions.

14260 **(EWE—2583) Validation of the vault computer model 'VERMIN' for post-closure behaviour of repositories in geological formations.** Laurens, J.-M. (Electrowatt Engineering Services Ltd., Horsham (UK); Department of the Environment, London (UK)). Oct 1987. 216p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88751829/JAW.

A validation methodology is proposed and applied to the computer model VERMIN, which is used to simulate radionuclide release from repositories for solid radioactive wastes. The processes included in the validation exercise are leaching from the waste matrix, diffusive transport and advective transport combined with sorption. Suggestions are made for new experimental studies relevant to VERMIN validation. In addition, VERMIN was used to simulate the behaviour of a repository in a clay formation and thus provide input for the geosphere model being used in the PACOMA study. Results from these simulations are reported.

14261 **(FLPU—84-11) Study of long term (10^3-10^4 yr) elemental migration in saturated clays and sediments. Part II.** MacKenzie, A.B.; Scott, R.D.; Ridgway, I.M.; McKinley, I.G.; West, J.M. (British Geological Survey, Keyworth. Fluid Processes Research Group). Jan 1984. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750832/JAW.

A study of the long term [10^3-10^4 yr] migration of certain elements, important in radioactive waste disposal, in saturated clays and sediments, has been conducted. Neutron activation analysis was carried out on Dubh Loch core, and the results provided evidence for migrational processes for certain of the twenty elements examined within the Loch Lomond sediments. Also desorption experiments are described for Cs, Sr, Ce, Co, I, Tc and Np onto bulk samples of lacustrine and marine sediments. The results reveal non-reversible behaviour for most of these radionuclides. (U.K.).

14262 **(FLPU—84-12) Cyltran: finite element programs for flow and mass transport under cylindrically symmetric conditions.** Noy, D.J. (British Geological Survey, Keyworth. Fluid Processes Research Group). Nov 1984. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750829/JAW.

A group of finite element programs are described which may be used for the analysis of complex single borehole hydraulic and tracer experiments in porous media. An outline is given of the theoretical development of the model and the computational procedures used. The equations are solved with the aid of routines specifically designed for efficient operation on vector processing machines. Finally, two simple examples of output generated by the programs are given.

14263 **(FLPU—85-12) Long term effects on potential repository sites: occurrence and diagenesis of anhydrite.** Bath, A.H.; George, I.A.; Milodowski, A.E.; Darling, W.G. (British Geological Survey, Keyworth. Fluid Processes Research Group). Oct 1985. 59p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750851/JAW.

The report deals with the long-term behaviour of anhydrite as a potential host rock for deep disposal of intermediate-level radioactive wastes. The principal long-term effect on the integrity of such a repository is the possibility of penetration of groundwater and consequent transformation to gypsum. Therefore, in order to assess the chydrological and geochemical processes of hydration in detail, mineralogical and geochemical analyses have been carried out on anhydrite samples in a drillcore taken near Darlington, United Kingdom. The results are discussed in terms of the long-term integrity of anhydrite as a repository site. (U.K.).

14264 **(FLPU—85-14) Tolerances of microorganisms to extreme environmental conditions.** West, J.M.; Arme, S.C. (British Geological Survey, Keyworth. Fluid Processes Research Group). Mar 1985. 72p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750806/JAW.

Microbial isolates from sites relevant to the disposal of radioactive wastes have been subjected to extreme environmental conditions in order to ascertain their tolerance ability. Two groups were chosen, sulphate reducing bacteria and sulphur oxidising bacteria, because of their potential effects on waste containment. They have been subjected to high temperatures, pressures and radiation (delta-emissions) in optimal media conditions and their ability to tolerate the conditions has been ascertained by epifluorescence microscopy and adenosine tri-phosphate (ATP) analysis followed by 'culture-on' to assess post experimental viability. Results indicate that the sulphate reducers in general, are more tolerant to these conditions than the sulphur oxidisers, some proving to be thermophilic. The sulphate reducer showed increased growth rates, as determined by population numbers, at 50°C and survived at 80°C, 4,500 psig (310 bar) with no subsequent loss in viability. Gamma irradiation of this group and an isolate of 10^8 rad over 4 hours had no effect on population numbers or viability. Such resistances are not apparent with the sulphur oxidisers whose numbers decreased with increasing radiation dose and are destroyed with pressure.

14265 **(FLPU—85-15) Reactivity of Ordinary Portland Cement (OPC) grout and various lithologies from the Harwell research site.** Milodowski, A.E.; George, I.A.; Bloodworth, A.J.; Robins, N.S. (British Geological Survey, Keyworth. Fluid Processes Research Group). Aug 1985. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750807/JAW.

Ordinary Portland Cement (OPC) has been used in the completion of boreholes on the Harwell Research Site, AERE, Oxfordshire. The purpose of this study was to examine the effect of OPC and the alkaline pore fluids generated during its setting on the various lithological types encountered in the boreholes. To facilitate this, samples of core representing the various rock types were selected and cement-rock composites were prepared from these in the laboratory to simulate the borehole cements. After a curing period of 15 months the cores and associated cement plugs were examined for any signs of reactivity or bonding. The best cement-rock bonding was shown by naturally well-cemented sandstone and limestone lithologies. Although no significant chemical reaction was seen to have occurred between OPC and rock, the OPC appears able to bind onto the rock surface because of the rigidity of the rock surface. Therefore, the best cement rock bonding and seal with OPC may be expected in the limestones of the Great Oolite Group, Inferior Oolite Group and parts of the Corallian Beds. Because of the reactivity of OPC towards certain lithologies a better borehole seal in such a sedimentary sequence might be achieved using a bentonite backfill in those parts of the sequence which either react with or bond only weakly to OPC.

14266 **(FLPU—86-3) Groundwater modelling for fractured and porous media: HYDROCOIN Level 1.** Noy, D.J. (British Geological Survey, Keyworth. Fluid Processes Research Group). Jan 1986. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750828/JAW.

The report describes work carried out as part of the 'Hydrocoin' project to verify some of the models used by the British Geological Survey on its radioactive waste disposal programme. The author's work on Hydrocoin Level 1 concerned groundwater modelling for fractured and porous media. The overall conclusions arising from the work were: a) pressure fields in saturated media can be reliably calculated by existing programmes, b) three techniques for deriving the flow fields are described, and c) severe practical limitations exist as to the ability of current programs to model variably saturated conditions over moderate distances. (U.K.).

14267 **(FLPU—86-5) Single hole tracer test to determine longitudinal dispersion.** Noy, D.J.; Holmes, D.C. (British Geological Survey, Keyworth. Fluid Processes Research Group). Mar 1986. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750827/JAW.

The paper concerns a single hole tracer test to determine longitudinal dispersion, which is an important parameter in assessing the suitability of a site for radioactive waste disposal. The theory, equipment and procedure for measuring longitudinal dispersion in a single borehole is described. Results are presented for field trials conducted in an aquifer, where the technique produced good results. The measured value of longitudinal dispersion, from a single hole test, relates only to a limited volume of rock immediately adjacent to the borehole. (U.K.).

14268 **(FMPC—2097) The waste minimization program at the Feed Materials Production Center.** Blasdel, J.E.; Crotzer, M.E.; Gardner, R.L.; Kato, T.R.; Spradlin, C.N. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). 1987. Contract AC05-86OR21600. 24p. (CONF-8711125—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004224/JAW.

From Symposium on waste minimization practice; Clearwater, FL, USA (12 Nov 1987).

A waste minimization program is being implemented at the Feed Materials Production Center to reduce the generation of uranium-contaminated wastes and to comply with existing and forthcoming regulations. Procedures and plans are described which deal with process and non-process trash, contaminated wood and metals, used metal drums, and major process wastes such as contaminated magnesium fluoride and neutralized raffinate. Waste minimization techniques used include segregation, source reduction, volume reduction, material substitution and waste/product recycle. The importance of training, communication, and incentives is also covered. 5 refs., 11 figs.

14269 (GSF—33/86, pp 1-49) **Investigations on model caverns.** Fischle, W.R.; Schwieger, K. 1986. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751492/JAW. (GSF-T—255).

In Storage and solidification of MAW/LAW in underground cavities. Investigations on model caverns.

The report is the first interim report which summarizes the results up to now on the production of the cavern and the first three fillings. Two caverns are empty at present and are ready for further experiments, which have become necessary due to the change of product composition at the beginning of the third project phase. Because of the inaccessibility of the prototype cavern, it was decided to carry out the filling of the last model cavern synchronously with the large experiment and with the original product, as because of the accessibility of the model cavern using bored cores, direct examination of the product is possible.

14270 (GSF—33/86, pp 1-7) **Annex 1: The setting up of a model cavern section at the former salt mine Asse II.** Raab, W.; Harms, W. 1986. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751492/JAW. (GSF-T—255).

In Storage and solidification of MAW/LAW in underground cavities. Investigations on model caverns.

Five model caverns in the former salt mine Asse II are being lined for the storage experiment with an inactive simulate of the reference product. A cavern section and a brine section is used in the older rock salt at the 800 m level. The brine section is used to collect the highly saturated salt solution occurring in solar work.

14271 (GSF—33/86, pp 1-7) **Annex 2: Investigations on loose material from cavern No. 5 at the 800 m level.** Herbert, H.J. 1986. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751492/JAW. (GSF-T—255).

In Storage and solidification of MAW/LAW in underground cavities. Investigations on model caverns.

Eight representative samples of the loose material from the floor of cavern 5 were examined macroscopically, microscopically and with the DTA in the laboratory.

14272 (GSF—33/86, pp 1-13) **Annex 3: Determining the hydration heat data of a granulate/filler mixture filled into a 10 m/sup 3/ model cavern.** Hauser, W. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Nukleare Entsorgungstechnik). 1986. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751492/JAW. (GSF-T—255).

In Storage and solidification of MAW/LAW in underground cavities. Investigations on model caverns.

One important aim of the model cavern experiments was a comparison of the measured product temperatures with the calculated time-and place-dependent temperature curves, from which conclusions can be drawn on the quality of temperature estimates for a large cavern.

14273 **(HR-EX—1378) Ocean disposal of radioactive waste. Stability of a waste repository on the ocean floor. Phase 2.** Anwar, H.O. (Hydraulics Research Station, Wallingford (UK); Department of the Environment, London (UK)). May 1985. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750809/JAW.

The occasionally high velocity burst varying between 20 and 60cms^{-1} were simulated in the laboratory flume; various parameters required for the design of a repository were measured. Scour tests were conducted when the flow obliquities varied between 0° and 45°, the ambient currents varied between 5 and 20cms^{-1}. In this series of experimental tests two repository models of the length scales 1:40 and 1:80 were employed and the results were compared. Various methods for measuring lift and drag forces were examined.

14274 **(IAEA-TECDOC—414) Behaviour of spent fuel assemblies during extended storage. Final report of a co-ordinated research programme on the behaviour of spent fuel assemblies during extended storage (BEFAST, phase 1, 1981-1986).** (International Atomic Energy Agency, Vienna (Austria)). Apr 1987. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700181/JAW.

This report is the final report of the IAEA Co-ordinated Research Programme on Behaviour of Spent Fuel Assemblies During Extended Storage (BEFAST, Phase I, 1981-86). It contains the results on wet and dry spent fuel storage technologies obtained from 11 institutes (10 countries: Austria, Canada, Czechoslovakia, Finland, German Democratic Republic, Hungary, Japan, Sweden, USA and USSR) participating in the BEFAST CRP during the time period 1981-86. Names of participating institutes and chief investigators are given. The interim spent fuel storage has been recognized as an important independent step in the nuclear fuel cycle. Due to the delay in commercial reprocessing of spent fuel in some cases it should be stored up to 30-50 years or more before reprocessing or final disposal. This programme was evaluated by all its participants and observers as very important and helpful for the nuclear community and it was decided to continue it further (1986-91) as BEFAST, Phase II. 36 references, 5 figures, 5 tables.

14275 **(INIS-GB—92) Solving the problem nobody wants.** Roberts, L.E.J. (British Association for the Advancement of Science, London). Jan 1987. 8p. (CONF-8508233—). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks., LS23 7BQ.

From Annual meeting British Association for the Advancement of Science -BA 85; Strathclyde, UK (26 Aug 1985).

The management of radioactive waste in the United Kingdom is examined. A description is given of the properties of radioactive wastes, relevant to waste management. Three options for dealing with the wastes are considered: dispersal to the environment, storage so that activity can decay, and disposal in repositories. The options are discussed with respect to the type and activity of radioactive waste. Finally the public perception of the disposal of nuclear waste is described. (U.K.).

14276 (INIS-mf—11096, pp 158-180) **Radioactive wastes from nuclear power facilities.** Suessmilch, J.; Vojtech, O. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 9 Dec 1986. (In Czech). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780047/JAW. (CONF-8610377—).

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

The economic and environmental impacts are discussed of wastes from nuclear power plants in the Czechoslovak situation where, in view of the planned extensive development of nuclear power and of the complex hydrogeological situation these problems are of special importance. The categories of wastes and the methods of their complete or temporary disposal are breifly characterized. Attention is especially paid to cementation and bituminization of wastes and to the incorporation of wastes in polymers. The individual techniques are compared using data from the literature, and the prospects are outlined of the development of solidification methods. The benefits of vitrification are stressed for waste processing in Czechoslovakia. It is primarily favoured in view of the fact

that the composition of wastes from normal operation of nuclear power plants is exceptionally advantageous for the simple procedure of vitrification, and small vitrification facilities allow processing of small amounts of high-level wastes of various composition, such as may result from accident situation of various types or during the final decommissioning of nuclear power plants. (Z.M.). 1 fig., 11 refs.

14277 **(IPEN-Pub—112, pp 31) Method for qualification of cementation processes and its application to a vibration mixer.** Vicente, R.; Rzyski, B.M.; Suarez, A.A. Jul 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88780012/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

In this paper the definition of homogeneneity is discussed and methods to measure the degree of heterogeneity of waste forms are proposed. These measurements are important as aids for mixing process qualification, and as tools in quality assurance procedures and in the development of waste management standards. Homogeneity is a basic quality requirement for waste forms to be accepted in final sites. It do not depend on the matrix immmobilization, rather it is one mean for qualification of the immobilization process. The proposed methods were applied to a vibration assisted mixing process and has proved to an useful mean to judge process improvements. There are many conceivable methods to evaluate homogeneity of waste forms. Some were selected as screening tests aiming at quickly reaching a promising set of process variables. Others were selected to evaluate the degree of excellence of the process in respect to product quality. These envisaged methods were: visual inspection, the use of cement dye as tracer, scanning of radioactive tracers, and measurements of variations of density, water absorption, porosity and mechanical strength across the waste form sample. The process variables were: waste-cement and water-cement ratios, mixer geometry, mixing time and vibration intensity. Some of the apparatus details were change during the experimental work in order to improve product quality. Experimental methods and results statistically analysed and compared with data obtained from samples prepared with a planetary paddle mixer, which were adopted as the homogeneity standard.

14278 **(JAERI-M—87-164) In situ buffer material test, (1). Compacted bentonite.** Kumata, Masahiro; Muraoka, Susumu; Shimooka, Kenji; Araki, Kunio; Okamoto, Masamichi. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 28p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751991/JAW.

Buffer materials would be placed between a package and wall rock in a disposal pit in a deep geological formation in the concept for geological disposal of high level radioactive wastes. A bentonite powder produced in our country was compacted in a test hole in-situ into 1.27 kg/cm/sup 3/ at 380 m below surface and heated with a electric heater about 882 hours. The value of obtained thermal conductivity of the buffer material was slightly larger than those of the laboratory data. The results of the measurements of the moisture of the buffer material using a Neutron Moisture Meter revealed that the buffer material was dried during the heating and groundwater penetrated from fractures of the wall rock into the buffer material after heating was stopped.

14279 **(LA—10987-PR) Research by ESS Division for the Nevada Nuclear Waste Storage Investigations: Progress report, January-June 1985.** Vaniman, D. (comp.). (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001940/JAW.

Petrographic research for the Nevada Nuclear Waste Storage Investigations focused on xenolithic variability in the Topopah Spring Member and on variations of clinoptilolite composition at Yucca Mountain. Zeolite and smectite occurrences were considered in terms of their relation to a disturbed zone beneath the potential repository, and mineral stability experiments have produced a new clinoptilolite structure as a result of prolonged heating at low temperature. Limitations were defined on the abundance of erionite and of sulfur. X-ray diffraction studies lead to improved analytical methods. Progress was made in the comparative study of mineralogy in sand ramps and in faults. Geological modeling considered the differences of the diffusion of nonsorbing tracers in vertically and in horizontally fractured rock. Modeling also treated the diffusion of a nonsorbing tracer in devitrified and in zeolitized rock. The results of these experiments in all cases show relatively symmetrical two-dimensional diffusion patterns. Preliminary calculations compare the dispersion/diffusion of nonsorbing Tc with the dispersion/diffusion/sorption of U. 27 refs., 20 figs., 5 tabs.

14280 **(LA—11162-MS) Methods for obtaining sorption data from uranium-series disequilibria.** Finnegan, D.L.; Bryant, E.A. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002512/JAW.

Two possible methods have been identified for obtaining in situ retardation factors from measurements of uranium-series disequilibria at Yucca Mountain. The first method would make use of the enhanced $^{234}U/^{238}U$ ratio in groundwater to derive a signature for exchangeable uranium sorbed on the rock; the exchangeable uranium would be leached and assayed. The second method would use the ratio of ^{222}Rn to ^{234}U in solution, corrected for weathering, to infer the retardation factor for uranium. Similar methods could be applied to thorium and radium.

14281 **(LA-UR—87-3951) Size and density of a ^{242}Pu colloid.** Rundberg, R.S.; Mitchell, A.J.; Torstenfelt, N.B. (Los Alamos National Lab., NM (USA); ASEA-ATOM AB, Vaesteraas (Sweden)). 1987. Contract W-7405-ENG-36. 5p. (CONF-871237—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003152/JAW.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1987).

The size and density of a ^{242}Pu colloid has been measured by autocorrelation photon spectrometry. The density of the colloid was determined by ultraspeed centrifugation. From the concentration profiles of ^{242}Pu in the centrifuged test tubes, a standard sedimentation formula was used to calculate the density; the size of the colloid was known from the light scattering experiments. The determined density of the ^{242}Pu colloid was unexpectedly low compared to the density of crystalline PuO_2. 5 refs., 1 tab.

14282 **(LBL—21121) Radionuclide migration through fractured rock: Effects of multiple fractures and two-member decay chains.** Ahn, J.; Chambre, P.L.; Pigford, T.H. (Lawrence Berkeley Lab., CA (USA)). Sep 1985. Contract AC03-76SF00098. 41p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004884/JAW.

This report presents the results of an analytical study of the hydrological transport of a radioactive contaminant through fractured, porous rock. The purpose is to evaluate the time-, and space-dependent concentration of the contaminant in the ground-water in the fractures and in the rock pores. We propose a simplified analytical method that superposes two single-fracture solutions for the concentration in the rock matrix with a system of parallel fractures. The exact solutions require multiple integrals and summation of an infinite series, which converges slowly because of its oscillating nature. The convergence of the series becomes slower for strongly-sorbing media, large spacing of two fractures, and early times. In summary, we made extension to the theory of radionuclide penetration into multiply fractured rock, and provided solutions for a two-member decay chain. 9 refs., 10 figs., 1 tab.

14283 **(LBL—23425) Radionuclide dispersion from multiple patch sources into a rock fracture.** Ahn, J.; Chambre, P.L.; Pigford, T.H.; Lee, W.W.L. (Lawrence Berkeley Lab., CA (USA)). Sep 1986. Contract AC03-76SF00098. 41p. (UCB-NE—4096). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004882/JAW.

This report presents results of an analytical study on hydrological transport of a radionuclide released from sources of finite areal extent into a planar fracture. The purposes of this work are to predict the space-time-dependent concentrations of a radionuclide which is released from multiple-patch (or area) sources and transported by advection and transverse dispersion in a planar fracture

and by molecular diffusion in rock matrix, and to investigate the effects of transverse dispersion in the fracture. 5 refs., 14 figs.

14284 **(LBL—23987) Transport of radioactive decay chains in finite and semi-infinite porous media.** Lung, H.C.; Chambre, P.L.; Pigford, T.H.; Lee, W.W.L. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 101p. (UCB-NE—4112). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004880/JAW.

This report presents analytic solutions, numerical implementation and numerical illustrations for the transport of radioactive decay chains of arbitary length in porous media of limited and unlimited extent. The analytic solutions for the problem of chains transport in finite and semi-infinite media are complicated. Sophisticated numerical methods were required in order to implement the solutions as computer programs. These steps are detailed in the report. The main part of this report are illustrations of the solutions with problems in nuclear waste disposal. We show the transport of two chains, uranium 234 to radium 226 and curium 245 to thorium, from concentration-limited boundary condition and Bateman-type boundary condition, in a porous region of limited extent such as a backfill and in a semi-infinite field. These illustrations are examples of the capabilities and usefulness of these solutions. 5 refs., 33 figs.

14285 **(NAGRA-NTB—80-02) Project study for the final disposal of high-level radioactive wastes in deep-lying geological formations and for intermediate storage.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1980. 127p. (In German). Nagra, CH-5401 Baden, Switzerland.

The present report has been written to show the feasibility of construction and the operational suitability of different intermediate and final storage concepts for high-level radioactive wastes. It summarizes the information from a project study given under contract by Nagra. The report should orient a broader public about the possible construction of such intermediate and final repositories. The work presented here refers to radioactive wastes which need an extremely long isolation time. Important information from a separate study concerning different aspects of the drilling of deep boreholes, has been integrated into the present report.

14286 **(NAGRA-NTB—80-03) Conceptual study for the final underground disposal of radioactive wastes with short-lived or limited toxicity.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Aug 1980. 86p. (In French). Nagra, CH-5401 Baden, Switzerland.

The project of a repository is a part of an iterative optimization process of the safety of disposal. It contains the specifications of the wastes admitted to the repository and the safety analyses of the repository containing the wastes. In a general way, the study has refined the idea of type A repositories as defined in the 1978 concept of NAGRA and has shown possibilities for realization. It could be shown that the realistic geologic conditions that have been considered will not hinder the construction of the repository. It has proved that the realization and maintenance of a reliable artificial barrier for 100 years is technically realizable. Technological alternatives are available to overcome the difficulties which will be met. The radiation protection of the working personnel will be assured through adequate conception of the installations and careful planning of the operations. The work and the equipment can be conceived without major difficulties in order that the risk incurred relative to various accidents is reduced to an acceptable level.

14287 **(NAGRA-NTB—80-04) Feasibility study for large diameter boreholes for the deep drilling concept of a high-level waste repository.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Oct 1980. 51p. Nagra, CH-5401 Baden, Switzerland.

The combustion of nuclear fuels generates radioactive wastes, some of which are very long lived and must be kept in confinement for very long periods, up to 100000 years. One proposed method of confinement is to bury the wastes containers in stable formations at depth of a few thousand metres, by means of holes drilled with existing oilwell equipment and techniques. This study endeavours to evaluate whether drilling these holes is possible with presently available technology. The conclusion is that it is possible today to drill and case holes with such a diameter and at such depth as required for the fulfilment of the various requirements laid down in the Deep Drilling Concept. In addition, it is possible to design a particular architecture for individual holes, which will allow the drilling of a large number of wells from a single location, thereby reducing as much as possible the impact of drilling operations on the environment.

14288 **(NAGRA-NTB—86-15) Degradation of concrete in a LLW/ILW repository.** Hoeglund, L.O. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jun 1987. 38p. Nagra, CH-5401 Baden, Switzerland.

The release rate of radionuclides from a Type B repository depends on the long-term properties of the concrete. The critical properties of the concrete are diffusivity and hydraulic conductivity. From calculations assuming a groundwater flow through the repository, it has been concluded that, besides the obvious risk of a fast nuclide release, the rate of concrete deterioration would also be increased compared to a situation where transport through the technical barriers takes place by diffusion only. The deterioration of concrete by aggresive species in the groundwater except by carbonation has been found to be less important than leaching by water. Also, possible chemical attack by sulfate, which is an expected constituent of the waste, could be reduced by the choice of a sulfate-resistant concrete. By appropriate design of barriers, the flow of groundwater through the repository can be minimized. This would assure that the only possible mass transfer mechanism would be diffusion. This would also decrease the influence of carbonation to an insignificant level. The rate of deterioration is low in this case. The possibility of microbial degradation of concrete has not been considered in this report.

14289 **(OAP-IE—85.71) Ocean disposal of heat generating radioactive waste. A review of site assessment studies.** (Ove Arup and Partners, London (UK); Department of the Environment, London (UK)). Dec 1985. 173p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750895/JAW.

The feasibility of safe ocean disposal options for heat-generating radioactive waste relies on the existence of suitable disposal sites. This review considers the status of the development of site selection criteria and the results of the study area investigations carried out under various national and international research programmes. In particular, the usefulness of the results obtained is related to the data needed for environmental and emplacement modelling. Preliminary investigations have identified fifteen potential deep ocean study areas in the North Atlantic. From these Great Meteor East (GME), Southern Nares Abyssal Plan (SNAP) and Kings Trough Flank (KTF) were selected for further investigation. The review includes appraisals of regional geology, geophysical studies, sedimentology, geotechnical studies, geochemical studies and oceanography.

14290 **(OAP-IE—86.24) Geological disposal of heat generating radioactive waste. Container design study - phase 2.** (Ove Arup and Partners, London (UK); Department of the Environment, London (UK)). Mar 1986. 162p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750904/JAW.

A number of options for the disposal of vitrified heat-generating radioactive waste are being studied to ensure that safe methods are available when the time comes for disposal operations to commence. This study has considered the feasibility of three designs for containers which would isolate the waste from the environment for a minimum period of 500 to 1000 years. The study was sub-divided into the following major sections: manufacturing feasibility; stress analysis; integrity in accidents; cost benefit review. The candidate container designs were taken from the results of a previous study by Ove Arup and Partners (1985) and were developed as the study progressed. Their major features can be summarised as follows: (A) a thin-walled corrosion-resistant metal shell filled with lead or cement grout. (B) an unfilled thick-walled carbon steel

shell. (C) an unfilled carbon steel shell planted externally with corrosion-resistant metal. Reference repository conditions in clay, granite and salt, reference disposal operations and metals corrosion data have been taken from various European Community radioactive waste management research and engineering projects. The study concludes that design Types A and B are feasible in manufacturing terms but design Type C is not. It is recommended that model containers should be produced to demonstrate the proposed methods of manufacture and that they should be tested to validate the analytical techniques used.

14291 **(OAP-IE—86.26) Ocean disposal of heat generating radioactive waste. Container cracking study.** (Ove Arup and Partners, London (UK); Department of the Environment, London (UK)). Mar 1986. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750893/JAW.

The objective of this study was to predict tensile stress levels in thin-walled titanium alloy and thick-walled carbon steel containers designed for the ocean disposal of heat-generating radioactive wastes. Results showed that tensile stresses would be produced in both designs by the expansion of the lead filter, for a temperature rise of 200°C. Tensile stress could be reduced if the waste heat output at disposal was reduced. Initial stresses for the titanium-alloy containers could be relieved by heat treatment.

14292 **(PB—88-117163/XAB) REPRISK code documentation. Volume 2. Final report.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). 1 Oct 1983. 197p. NTIS, PC A09/MF A01.

See also PB—88-111414.

To assist the Environmental Protection Agency in evaluating releases from a variety of combinations of geologic settings, radionuclide inventories, mechanisms and pathways for radioactive releases, time frames, and dose-uptake pathways, a computer model based on the results of these technical investigations was developed. The model is called REPRISK. The report is documentation for the REPRISK code. It concentrates on the mechanics of the model.

14293 **(PNL—6353-Vol.1) Comprehensive data base of high-level nuclear waste glasses: September 1987 status report: Volume 1, Discussion and glass durability data.** Kindle, C.H.; Kreiter, M.R. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 276p. NTIS, PC A13. Order Number DE88004754/JAW.

The Materials Characterization Center (MCC) at Pacific Northwest Laboratory is assembling a comprehensive data base (CDB) of experimental data collected for high-level nuclear waste package components. Data collected throughout the world are included in the data base; current emphasis is on waste glasses and their properties. The goal is to provide a data base of properties and compositions and an analysis of dominant property trends as a function of composition. This data base is a resource that nuclear waste producers, disposers, and regulators can use to compare properties of a particular high-level nuclear waste glass product with the properties of other glasses of similar compositions. Researchers may use the data base to guide experimental tests to fill gaps in the available knowledge or to refine empirical models. The data are incorporated into a computerized data base that will allow the data to be extracted based on, for example, glass composition or test duration. 3 figs.

14294 **(PNL—6353-Vol.2) Comprehensive data base of high-level nuclear waste glasses: September 1987 status report: Volume 2, Additional appendices.** Kindle, C.H.; Kreiter, M.R. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 138p. NTIS, PC A07. Order Number DE88004755/JAW.

The Materials Characterization Center (MCC) is assembling a comprehensive data base (CDB) of experimental data collected for high-level nuclear waste package components. The status of the CDB is summarized in Volume I of this report. Volume II contains appendices that present data from the data base and an evaluation of glass durability models applied to the data base.

14295 **(PNL—6403) Recharge at the Hanford Site: Status report.** Gee, G.W. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004908/JAW.

A variety of field programs designed to evaluate recharge and other water balance components including precipitation, infiltration, evaporation, and water storage changes, have been carried out at the Hanford Site since 1970. Data from these programs have indicated that a wide range of recharge rates can occur depending upon specific site conditions. Present evidence suggests that minimum recharge occurs where soils are fine-textured and surfaces are vegetated with deep-rooted plants. Maximum recharge occurs where coarse soils or gravels exist at the surface and soils are kept bare. Recharge can occur in areas where shallow-rooted plants dominate the surface, particularly where soils are coarse-textured. Recharge estimates have been made for the site using simulation models. A US Geological Survey model that attempts to account for climate variability, soil storage parameters, and plant factors has calculated recharge values ranging from near zero to an average of about 1 cm/yr for the Hanford Site. UNSAT-H, a deterministic model developed for the site, appears to be the best code available for estimating recharge on a site-specific basis. Appendix I contains precipitation data from January 1979 to June 1987. 42 refs., 11 figs., 11 tabs.

14296 **(PNL-SA—14900) Basic concepts involved in the leaching of waste forms.** Mendel, J.E. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 10p. (CONF-870802—36). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003428/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

The Environmental Protection Agency and Department of Energy, as well as industry scientists, all perform leach tests on radioactive or hazardous chemical wastes. An effort has been initiated to increase communication between all scientists conducting leach tests. The following topics are thus discussed: need for a common terminology; differences in DOE and EPA application; common aspects of leaching; transient effects; steady-state conditions; relationship of systems analyses and leach tests; definition and other applications of leaching. 2 refs., 3 figs.

14297 **(PNL-SA—15147) Fabrication of isotopic heat and radiation sources for the Federal Republic of Germany.** McElroy, J.L.; Holton, L.K. Jr.; Burkholder, H.C.; Bryan, G.H.; Minor, J.E. (Pacific Northwest Lab., Richland, WA (USA); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen (Germany, F.R.). Inst. fuer Tieflagerung). Sep 1987. Contract AC06-76RL01830. 6p. (CONF-870801—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002082/JAW.

From International conference on nuclear fuel reprocessing and waste management; Paris, France (24 Aug 1987).

Pacific Northwest Laboratory (PNL) has filled 30 German-made canisters with highly radioactive borosilicate glass. These canisters, containing specified amounts of ^{137}Cs and ^{90}Sr, will be sealed using a gas tungsten arc welder and will be decontaminated to nonsmearable limits using an electropolishing system. They are to be characterized in a series of nondestructive tests: surface dose rate measurement, axial gamma scanning, canister mass determination, and canister surface temperature measurement. The canisters will then be transported to the Asse Salt Mine located in the Federal Republic of Germany (FRG) for a 5-year repository testing program. 3 refs., 2 figs., 1 tab.

14298 **(RFP—4177) Actinide removal from nitric acid waste streams.** Muscatello, A.C.; Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 15 Oct 1987. Contract AC04-76DP03533. 36p. (CONF-871101—80). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005192/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

Actinide separations research at the Rocky Flats Plant (RFP) has found ways to significantly improve plutonium secondary recovery and americium removal from nitric acid waste streams generated by plutonium purification operations. Capacity and breakthrough studies show anion exchange with Dowex 1 x 4 (50 to 100 mesh) to be superior for secondary recovery of plutonium. Extraction chromatography with TOPO(tri-n-octyl-phosphine oxide) on XAD-4 removes the final traces of plutonium, including hydrolytic polymer. Partial neutralization and solid-supported liquid-membrane transfer removes americium for sorption on discardable inorganic ion exchangers, potentially allowing for non-TRU waste disposal.

14299 **(SAND—84-2641-Vol.5) Site characterization plan: Conceptual design report: Volume 5, Appendices P-R: Nevada Nuclear Waste Storage Investigations Project.** MacDougall, H.R.; Scully, L.W.; Tillerson, J.R. (comps.). (Sandia National Labs., Albuquerque, NM (USA); Bechtel National, Inc., San Francisco, CA (USA); Parsons, Brinckerhoff, Quade and Douglas, Inc., San Francisco, CA (USA)). Sep 1987. Contract AC04-76DP00789. 789p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88004781/JAW.

The site for the prospective respository is located at Yucca Mountain in southwestern Nevada, and the waste emplacement area will be constructed in the underlying volcanic tuffs. The target horizon for waste emplacement is a sloping bed of densely welded tuff more than 650 ft below the surface and typically more than 600 ft above the water table. The conceptual design described in this report is unique among repository designs in that it uses ramps in addition to shafts to gain access to the underground facility, the emplacement horizon is located above the water table, and it is possible that 300- to 400-ft-long horizontal waste emplacement boreholes will be used. This report summarizes the design bases, design and performance criteria, and the design analyses performed. The current status of meeting the preclosure performance objectives for licensing and of resolving the repository design and preclosure issues is presented. The repository design presented in this report will be expanded and refined during the advanced conceptual design, the license application design, and the final procurement and construction design phases. Volume 5 contains appendices P through R.

14300 **(SAND—86-2178C) Estimates of cumulative releases of radionuclides to the water table from a repository at Yucca Mountain, Nevada.** Tierney, M.S.; Bingham, F.W. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 13p. (CONF-860911—31-Summ.). NTIS, PC A03. Order Number DE88002422/JAW.

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

Expected cumulative releases of radioactivity to the water table under a nuclear waste repository at Yucca Mountain, Nevada, are estimated for a period of 10,000 years after closure of the repository using a simple mathematical model, a ground-water travel time distribution based on a hydrologic model of the site's unsaturated zone, and measured sorption ratios of the radionuclide species in Yucca Mountain water chemistry. Only non-sorbing species, C-14, I-129 and Tc-99, are released to the water table in the 10,000-year period from a repository containing 70,000 MTU of spent fuel; the cumulative release is estimated to be about one ten-millionth of the release limit allowed in the applicable standard governing long-term containment of nuclear wastes in a geologic repository. 3 refs., 7 figs.

14301 **(SAND—87-1977) A constitutive model for the consolidation of WIPP [Waste Isolation Pilot Plant] crushed salt and its use in analyses of backfilled shaft and drift configurations.** Sjaardema, G.D.; Kreig, R.D. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002820/JAW.

A constitutive model for the consolidation of wet crushed salt material is presented. The material parameters for this model are derived from hydrostatic consolidation tests performed on wet salt taken from the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. The constitutive model is then used for analyses of the interaction between intact and crushed salt in realistic field configurations such as backfilled and open shafts and drifts. The calculations are used to show that the wet crushed salt does not significantly retard the rate of closure of shafts and drifts until the crushed salt is consolidated to approximately 95% of intact salt density. An approximate method for modeling the creep rate of intact salt is developed which more closely matches the closure data from empty drifts at the WIPP site in order to provide a more realistic estimate of the crushed salt response. 24 refs., 34 figs., 4 tabs.

14302 **(SAND—87-2068C) Quality assurance and maintenance of waste management computer software.** Harlan, C.P.; Wilkinson, G.F. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880201—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004685/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

The US Nuclear Regulatory Commission (NRC) has the responsibility of licensing sites for future disposal of commercial high-level radioactive waste. Sandia National Laboratories is assisting the NRC in this effort by developing and demonstrating performance assessment methodologies for evaluating high-level radioactive waste repositories in deep geologic formations. These methodologies include the development and application of computer programs. A computer software maintenance and quality assurance plan has been developed as a part of this effort. The plan and its implementation at Sandia are described in this paper. 4 refs., 2 figs.

14303 **(SAND—87-2598C) Radiological assessment of the consequences of the disposal of high level radioactive waste in sub-seabed sediments.** de Marsily, G.; Behrendt, V.; Ensminger, D.A.; Flebus, C.; Hutchinson, B.L.; Kane, P.; Karpf, A.; Klett, R.D.; Mobbs, S.; Poulin, M. (Ecole Nationale Superieure des Mines, 75 - Paris (France); Dornier-System G.m.b.H., Friedrichshafen (Germany, F.R.); Analytical Sciences, Inc., Research Triangle Park, NC (USA); Commission of the European Communities, Ispra (Italy). Joint Research Centre; Glosten Associates, Inc., Seattle, WA (USA); Sandia National Labs., Livermore, CA (USA)). 1987. Contract AC04-76DP00789. 2p. (CONF-871101—66). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002324/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

The radiological assessment of the Seabed option consists of estimating the detriment to man and to the environment that could result from the disposal of high-level nuclear waste within the seabed sediments in the deep oceans. The assessment is made for the high-level waste (vitrified glass) produced by the reprocessing of 10^5 tons of heavy metal from spent fuel, which represents the amount of waste generated by 3333 reactor-years of 900 MW(e) reactors, i.e., 3000 GW(E).a. The disposal option considered is to use 14,667 steel penetrators, each of them containing five canisters of HLW glass (0,15 m^3 each). These penetrators would reach a depth of 50 m in the sediments and would be placed at an average distance of 180 m from each other, requiring a disposal area on the order of 22 x 22 km. Two such potential disposal areas in the Atlantic ocean were studied, Great Meteor East (GME) and South Nares Abyssal Plains (SNAP). A special ship design is proposed to minimize transportation accidents. Approximately 100 shipments would be necessary to dispose of the proposed amount of waste. 1 ref.

14304 **(SRD-R—388) Radioactive waste disposal by UKAEA establishments during 1984 and associated environmental monitoring results.** Meggitt, G.C.; Graham, A.C. (UKAEA Safety and Reliability Directorate, Culcheth). Apr 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750822/JAW.

Details are given of the amounts of solid and liquid radioactive waste disposed of by the principal Establishments of the UKAEA during 1984. Waste arising at the UKAEA Nuclear Power Development Laboratories at Windscale and Springfields, which are both situated on British Nuclear Fuels plc (BNF plc) sites, is disposed of by BNF plc and included in their authorisations. Discharges to the atmosphere of airborne radioactive waste are also included in the report. A summary of the results of the environmental monitoring programmes carried out in connection with the radioactive waste discharges is given.

14305 **(UCRL—53795) Reaction of vitric Topopah Spring Tuff and J-13 ground water under hydrothermal conditions using Dickson-type, gold-bag rocking autoclaves.** Knauss, K.G.; Peifer, D.W. (Lawrence Livermore National Lab., CA (USA)). Nov 1986. Contract W-7405-ENG-48. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005234/JAW.

In support of the Nevada Nuclear Waste Storage Investigations Project, we conducted experiments to study the effects of repository-generated heat on glassy tuff present at Yucca Mountain, Nevada. Solid wafers of glassy tuff were reacted with a dilute ground water for several months at 250, 150, and 90°C at 100 bar pressure in Dickson-type, gold-bag rocking autoclaves. The in-situ chemistry of the hydrothermal fluids was modeled; and the chemical affinities for all possible mineral precipitation reactions for species contained within the database were calculated using the EQ3/6 program. For the 250°C experiment, the calculations predicted the precipitation of a zeolite mineral. Analyses of the run products showed that the wafer had been extensivley corroded, the glass shards were replaced by clinoptilolite (a zeolite), and pure clinoptilolite precipitated directly from solution. Modeling of the 150°C experiment indicated that, although clay minerals were thermodynamically more highly supersaturated than zeolites in the first half of the experiment, by the end of the run a zeolite mineral was also predicted to precipitate. Analyses of the run products showed that no well-crystallized secondary minerals (clays or zeolites) had formed. In the 90°C experiment, the degree of superstaturation fo: both clays and zeolites was lower than at either of the higher temperatures. The relative change in super-saturation for any one mineral was also lower as the run progressed. At the lower temperature (90 and 150°C), slow precipitation kinetics may preclude the formation of the zeolite within the time span of these experiments. In general, the actual observations are in relatively good agreement with the geochemical model calculations made at each temperature.

14306 **(UCRL—96555-Rev.1) Thermodynamic data bases for multivalent elements: An example for ruthenium.** Rard, J.A. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 29p. (CONF-870594—1-Rev.1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004395/JAW.

From International conference on thermodynamics of aqueous systems with industrial applications; Warrenton, VA, USA (10 May 1987).

A careful consideration and understanding of fundamental chemistry, thermodynamics, and kinetics is absolutely essential when modeling predominance regions and solubility behavior of elements that exhibit a wide range of valence states. Examples of this are given using the ruthenium-water system at 298.15 K, for which a critically assessed thermochemical data base is available. Ruthenium exhibits the widest range of known aqueous solution valence states. Known solid anhydrous binary oxides of ruthenium are crystalline RuO_2, RuO_4, and possibly RuO_3 (thin film), and known hydroxides/hydrated oxides (all amorphous) are $Ru(OH)_3 \cdot H_2O$, $RuO_2 \cdot 2H_2O$, $RuO_3 \cdot H_2O$, and a poorly characterized Ru(V) hydrous oxide. Although the other oxides, hydroxides, and hydrous oxides are generally obtained as precipitates from aqueous solutions, they are thermodynamically unstable with regard to RuO_2(cr) formation. Characterized aqueous species of ruthenium include RuO_4 (which slowly oxidizes water and which dissociates as a weak acid), RuO_4^- and RuO_4^{2-} (which probably contain lesser amounts of $RuO_3(OH)_2^-$ and $RuO_3(OH)_2^{2-}$, respectively, and other species), $Ru(OH)_2^{2+}$, $Ru_4(OH)_{12}^{4+}$, $Ru(OH)_4$, Ru^{3+}, $Ru(OH)^{2+}$, $Ru(OH)_2^+$, Ru^{2+}, and some hydroxytetramers with formal ruthenium valences of $3.75 \geq Z \geq 2.0$. Potential pH diagrams of the predominance regions change significantly with concentration due to polymerization/depolymerization reactions. Failure to consider the known chemistry of ruthenium can yield large differences in predicted solubilities.

14307 **(USGS-OFR—87-409) Photogeologic study of small-scale linear features near a potential nuclear-waste repository site at Yucca Mountain, southern Nye County, Nevada.** Throckmorton, C.K. (Geological Survey, Denver, CO (USA)). 1987. Contract AI08-78ET44802. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005001/JAW.

Linear features were mapped from 1:2400-scale aerial photographs of the northern half of the potential underground nuclear-waste repository site at Yucca Mountain by means of a Kern PG 2 stereoplotter. These features were thought to be the expression of fractures at the ground surface (fracture traces), and were mapped in the caprock, upper lithophysal, undifferentiated lower lithophysal and hackly units of the Tiva Canyon Member of the Miocene Paintbrush Tuff. To determine if the linear features corresponded to fracture traces observed in the field, stations (areas) were selected on the map where the traces were both abundant and located solely within one unit. These areas were visited in the field, where fracture-trace bearings and fracture-trace lengths were recorded. Additional data on fracture-trace length and fracture abundance, obtained from ground-based studies of cleared pavements located within the study area were used to help evaluate data collected for this study. 16 refs., 4 figs., 2 tabs.

14308 **(WER—1-1985) Annual report on radioactive discharges and monitoring the environment 1985.** (UKAEA Atomic Energy Establishment, Winfrith). Jul 1986. 66p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750911/JAW.

This Winfrith report is arranged in two main sections, one detailing waste discharges to sea and the associated environmental monitoring, and the other, similar information for airborne aspects. To assist in public understanding, graphical presentations with explanatory footnotes are used but the detailed numerical information is included in Tables. Where appropriate, Authorised discharge levels are referred to.

14309 **(WHC-EP—0044) Hanford Waste Vitrification Plant reference conceptual design report.** (Westinghouse Hanford Co., Richland, WA (USA)). Jul 1987. Contract AC06-87RL10930. 262p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88004501/JAW.

This document describes the Reference Conceptual Design (RCD) of the Hanford Waste Vitrification Plant (HWVP). The HWVP will immobilize pretreated Hanford defense liquid high-level waste prior to shipment to a geologic repository, satisfying an objective in the President's Defense Waste Management Plan. The HWVP will vitrify the waste in borosilicate glass, cast the glass into stainless steel canisters, and store the canisters at Hanford until they are shipped to a Federal Geologic Repository. The HWVP will support a glass production rate of 100 pounds per hour. The annual production goal of 610,000 pounds of glass is based on 70% plant availability, excluding downtime for Melter replacement. The HWVP will be located approximately 2000 feet southwest of B-Plant in the 200 East Area of the Hanford Site and will occupy an area approximately 1200 feet by 1200 feet. The RCD cost estimate for the HWVP is $920 million. Hot startup of the HWVP is currently scheduled for Fiscal Year 1999. 9 refs., 19 figs., 17 tabs.

14310 **Waste disposal package.** Smith, M.J. (to Department of Energy, Washington, DC (USA)). British Patent 2176925/A/. 7 Jan 1987. Priority date 19 Jun 1985, United States of America (USA), 5p. Patent Office, 25 Southampton Buildings, London, WC2A 1AY.

US priority 746597.

A waste disposal package including an inner or primary canister for containing hazardous and/or radioactive wastes. The primary canister is encapsulated by an outer or secondary barrier forming a porous mechanical barrier to control ingress of water to the canister and the release rate of wastes upon breach of the canis-

ter. The barrier is preferably a ceramic material and is formed of a plurality of separate assemblable sections.

14311 **Nuclear Waste Policy Act Amendments Act of 1987. Introduced in the United States Senate, One Hundredth Congress, First Session, September 1, 1987.** Washington, DC; Government Printing Office (1987). 223p.

The purpose of the bill is to redirect the program for the management and disposal of spent nuclear fuel and high-level radioactive waste under the Nuclear Waste Policy Act of 1982 (NWPA) to provide for: (1) sequential characterization of candidate sites for a geologic repository for disposal of nuclear waste; (2) construction of a monitored retrievable storage facility for spent nuclear fuel as part of an integrated nuclear waste management system; and (3) benefits payments with respect to a repository or a monitored retrievable storage facility to States, Indian tribes and units of local government as appropriate. Section-by-section changes are noted in the Summary of major provisions. The following statements are included: John S. Herrington, Secretary of Energy, January 29, 1987; Ben C. Rusche, Director, Office of Civilian Radioactive Waste Management, DOE, April 28, 1987; Donald L. Vieth, Waste Management Project Office, Nevada Operations Office, DOE, June 29, 1987; John H. Anttonen, Basalt Waste Isolation Project, Richland Operations Office, DOE, June 29, 1987; Ben C. Rusche, July 16, 1987; Hugh L. Thompson, Office of Nuclear Material Safety and Safeguards, US NRC, April 28, 1987; and Robert Borneo, same office, US NRC, June 29, 1987. Also included is a report by Elizabeth Peelle, Energy Division, Oak Ridge National Lab., The MRS Task Force: Economic and Non-economic Incentives for Local Public Acceptance of a Proposed Nuclear Waste Packaging and Storage Facility.

14312 **Establishing a Nuclear Waste Policy Review Commission, and Office of the Nuclear Waste Negotiator, and for other purposes. House of Representatives, One Hundredth Congress, First Session, November 5, 1987.** Washington, DC; Government Printing Office (1987). 31p.

H.R. 2967 is also known as the Nuclear Waste Policy Amendments Act of 1987. The purpose of H.R. 2967 is to restore direction and credibility to the program for siting repositories for the safe and permanent disposal of spent nuclear fuel and high-level radioactive waste. The bill would accomplish this purpose by: (1) establishing a commission to review the technical integrity and soundness of the Dept. of Energy's (DOE) past efforts to implement the nuclear waste program and to recommend necessary corrections to the Congress; (2) establishing a special negotiator to find a state or Indian tribe willing to host a nuclear waste repository at a technically qualified site; and (3) establishing an independent technical review board to evaluate the technical and scientific validity of DOE's future efforts to implement the nuclear waste program.

14313 **High-level nuclear waste issues. Hearings before the Subcommittee on Nuclear Regulation of the Committee on Environment and Public Works, United States Senate, One Hundredth Congress, First Session, April 23; June 2, 3, and 18, 1987.** Washington, DC; Government Printing Office (1987). 833p.

There were 41 witnesses testifying over a period of four days during an examination of nuclear waste policy, which has turned out to be a controversial program as it focuses on waste repository sites. The witnesses included Energy Secretary John Herrington, representatives from all levels of government of affected states, environmentalists, concerned citizens, health and transportation officials, and government agencies. Much of the hearing focused on the proposed construction of a monitored retrievable storage (MRC) facility and the anticipated impact on the site and surrounding areas. Additional material submitted for the record follows the opening statements and testimony for each hearing day.

14314 **Appalachian States Low-Level Radioactive Waste Compact Consent Act. House of Representatives, One Hundredth Congress, First Session, October 7, 1987.** Washington, DC; Government Printing Office (1987). 4p.

The House committee report on H.R. 3025 recommends passage without amendment of the bill to establish the Appalachian States compact to serve Pennsylvania, Delaware, Maryland, and West Virginia. The report reviews the need for establishing cooperative regional approaches to siting and developing storage facilities. The compact agreement precludes the export of low-level wastes outside the compact area. Only one witness spoke at the committee hearing. The report concludes with findings that the bill will have no significant economic impact and correspondence noting that states have the responsibility for dealing with low-level wastes.

14315 **Ground-water monitoring and modeling at the Hanford Site.** Mitchell, P.J.; Freshley, M.D. (Pacific Northwest Lab., Richland, WA 99352). pp 351-356 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC06-76RL01830.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The ground-water monitoring program at the Hanford Site in southeastern Washington State is continually evolving in response to changing operations at the site, changes in the groundwater flow system, movement of the constituents in the aquifers, and regulatory requirements. Sampling and analysis of ground water, along with ground-water flow and solute transport modeling are used to evaluate the movement and resulting distributions of radionuclides and hazardous chemical constituents in the unconfined aquifer. Evaluation of monitoring results, modeling, and information on waste management practices are being combined to continually improve the network of ground-water monitoring wells at the site.

14316 **Environmental surveillance of EG and G Idaho waste management facilities at the Idaho National Engineering Laboratory.** Hedahl, T.G.; Reyes, B.D. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID 83415). pp 365-372 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC07-76ID01570.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The EG and G Idaho, Inc. Environmental Surveillance Program performs routine and special environmental monitoring of waste management facilities at the Idaho National Engineering Laboratory (INEL). This comprehensive program includes air, water, soil, biotic, and ambient radiation monitoring at six waste management facilities. Routine monitoring activities primarily involve environmental sampling and analyses for gross alpha/beta, gamma-emitting radionuclides, and specific alpha- and beta-emitting constituents. The environmental monitoring activities performed at EG and G Idaho waste management facilities are described. Past data results are also evaluated and discussed. One special monitoring study performed during 1986 is also described.

14317 **US cooperation with other nations in nuclear waste disposal.** Cooley, C.R.; Strahl, J.F. (Office of Policy and Outreach, Office of Civilian Radioactive Waste Management, U.S. Dept. of Energy, Washington, DC). pp 129-136 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The major areas of cooperation in high-level radioactive waste disposal between the US and other nations and international organizations are identified, focusing on those activities associated with the US Department of Energy. The various means by which activities are identified and implemented are discussed. Information and experience gained through past cooperative efforts at underground research laboratories in other nations is provided along with those activities performed to enhance the development of repository predictive response models. The benefits associated with participation in these cooperative efforts are also discussed.

14318 **Transuranic waste examination quality assurance at the Idaho National Engineering Lab.** Bower, J.M. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID 83415). pp 301-304 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC07-76ID01570.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Since 1954, defense-generated transuranic (TRU) waste has been received at the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering Laboratory (INEL). A major objective of the Department of Energy (DOE) Nuclear Waste Management Programs is the proper management of the defense-generated TRU waste. The Stored Waste Examination Pilot Plant (SWEPP) is providing nondestructive examination and assay of retreivably stored contact handled TRU waste in order to certify it to the Waste Isolation Pilot Plant Waste Acceptance Criteria (WIPP-WAC). The purpose of this paper is to discuss the methods utilized by SWEPP for checking on the examination process and to ensure that waste certifications are being properly performed. Included is the application of the quality assurance techniques to each examination system, the management of data generated by the examination, and the verification's to ensure accurate certification.

14319 **The added level of quality assurance provided by the WIPP contact-handled and remote-handled waste demonstrations.** Halverson, T.W.; Chiquelin, W.R. (Westinghouse Electric Corp., Carlsbad, NM 88220). pp 305-310 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

This paper discusses the contact-handled (CH) and remote-handled (RH) mock waste emplacement and retrieval demonstrations which will be conducted at the Waste Isolation Pilot Plant (WIPP). The retrieval demonstrations are performed as a requirement that was established by the Consultation and Cooperation Agreement between the State of New Mexico and the Department of Energy. The demonstrations are used to document the retrievability of all waste forms from the WIPP should waste retrieval ever become necessary. This paper describes each of the mock waste demonstrations, including scope and magnitude, how and where demonstrations will be conducted, and what criteria will be evaluated to verify the success of the demonstrations.

14320 **Subsurface investigations at the radioactive waste management complex of the Idaho National Engineering Laboratory.** Russell, B.F.; Hubbell, J.M.; Humphrey, T.G. (Idaho National Engineering Lab., Idaho Falls, ID 83415). pp 373-380 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC07-76ID01570.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Subsurface Investigation Program is a part of a continuing effort at the Radioactive Waste Management Complex (RWMC) of the Idaho National Engineering Laboratory (INEL) to identify potential pathways and mechanisms for waste radionuclides to migrate through the unsaturated and saturated zones, and eventually to man. The objects of this program are to: develop a field calibrated computer model to predict the long-term migration of radionuclides in the unsaturated zone, and measure the actual migration of radionuclides to date, in order to determine whether there is a problem from a public health and safety standpoint. Four methods for the collection of data in support of these objectives and several specific studies have been initiated. Two years of field data has been collected and techniques refined. Installation of instrumentation and contamination control techniques have been thoroughly tested and demonstrated to be effective. Specific methods and studies are presented including a discussion of the contamination-control measures and a variety of unsaturated zone instrumentation employed for the study.

14321 **Monitoring of heat and moisture migration from radioactive waste disposed in an augered shaft.** Williams, R.E.; Mc Grath, D.A.; Boland, J.R. (Reynolds Electrical and Engineering Co., Inc., P.O. Box 14400, Las Vegas, NV 89114). pp 381-386 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Soil temperature and moisture data have been collected for the past 4 years at the Greater Confinement Disposal Test (GCDT) being conducted at the Nevada Test Site. High-specific-activity radioactive waste with a thermal output of 3.4 kW was buried at a depth of 30 m in tuffaceous alluvium. Prior to waste emplacement the ambient subsurface temperature was about 17°C and the volumetric soil moisture content was 10-12%. Two years after waste emplacement the soil temperature exceeded 100°C and the soil moisture content dropped below 4% at a radius of approximately 3 m from the thermal waste. Drying of the soil has occurred as the high temperature radiating from the thermal sources propels water vapor from the waste zone to a zone where dew-point temperatures are reached. The temperature and moisture data will be used in combination with data from gaseous tracer release tests in predicting and appraising the long-term performance of the GCDT.

14322 **Improved confinement technology for buried transuranic waste.** Low, J.O.; Clements, T.L. Jr. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID 83401). pp 495-500 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC07-76ID01570.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Since 1954, defense-generated transuranic (TRU) waste has been received at the Idaho National Engineering Laboratory (INEL) Radioactive Waste Management Complex (RWMC). Before 1970, approximately 57,100 cubic meters of transuranic waste were buried in shallow-land trenches and pits at the RWMC. A major objective of the Department of Energy (DOE) Nuclear Waste Management Program is the environmentally safe management of defense-generated transuranic waste. Strategies have been developed for managing INEL buried TRU waste and have been incorporated in the DOE Defense Waste Management Plan. The INEL is conducting studies to develop technology to support selection of a long-term management alternative for INEL buried TRU waste in 1995. In situ grouting is being evaluated as an improved confinement technique for INEL buried TRU waste. During this 2 year program different grout formulas were developed for arid unsaturated conditions; a simulated test pit was constructed, instrumented, and in situ grouted; and post-grouting examination of the pit was completed.

14323 **Dry rod consolidation technology development.** Rasmussen, T.L.; Schoonen, D.H.; Feldman, E.M.; Fisher, M.W. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID 83415). pp 555-562 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC07-76ID01570.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM) is funding a program to consolidate commercial spent fuel for testing in dry storage casks and to develop technology that will be fed into other OCRWM programs, e.g., Prototypical Consolidation Demonstration Program (PCDP). The program is being conducted at the Idaho National Engineering Laboratory (INEL) by the INEL Operating Contractor EG and G Idaho, Inc. Hardware and software have been de-

signed and fabricated for installation in a hot cell adjacent to the Test Area North (TAN) Hot Shop Facility. This equipment is used to perform dry consolidation of commercial spent fuel from the Virginia Power (VP) Cooperative Agreement Spent Fuel Storage Cask (SFSC) Demonstration Program and assemblies that had previously been stored at the Engine Maintenance and Disassembly (EMAD) facility in Nevada. Consolidation is accomplished by individual, horizontal rod pulling. A computerized semiautomatic control system with operator involvement is utilized to conduct consolidation operations. During consolidation operations, data is taken to characterize this technology. Still photo, video tape, and other documentation will be generated to make developed information available to interested parties. Cold checkout of the hardware and software was completed in September of 1986. Following installation in the hot cell, consolidation operations begins in May 1987. Resulting consolidated fuel will be utilized in the VP Cooperative Agreement SFSC Program.

14324 **Electropolishing decontamination system for high-level waste canisters.** Larson, D.E.; Allen, R.P.; Berger, D.N.; Bryan, G.H.; Place, B.G. (Pacific Northwest Lab., Richland, WA 99352). pp 547-554 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

As part of a U.S. Department of Energy (DOE) project agreement with the Federal Ministry for Research and Technology (BMFT) in the Federal Republic of Germany (FRG), The Nuclear Waste Treatment Program at the Pacific Northwest Laboratory (PNL) is preparing 30 radioactive canisters containing borosilicate glass for use in high-level waste repository related tests at the Asse Salt Mine. After filling, the canisters will be welded closed and decontaminated in preparation for shipping to the FRG. Electropolishing was selected as the primary decontamination approach, and an electropolishing system with associated canister inspection equipment has been designed and fabricated for installation in a large hot cell. This remote electropolishing system, which is currently undergoing preliminary testing, is described in this report.

14325 **Shielding methods for evaluating the versatility of proposed shipping casks.** Bucholz, J.A. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **54**: 296-298(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

After a shipping cask has been designed for a certain type of spent fuel, the number of assemblies it can carry is fixed, as are the thicknesses of the various steel shells, the neutron shield, and the gamma shield. The question then becomes What other types of spent fuel may be shipped in the cask? Using the same neutron and gamma source terms, miscellaneous correlations, and one-group cross sections found in the Capsize program, a fast new interactive shielding program called KWIKDOSE has been written for the IBM-PC, which computed and displays a two-dimensional table showing the total dose rate 10 ft from the centerline of a cask as a function of the spent fuel's burnup and cooling time. The paper shows some of the results corresponding to a hypothetical cask containing 21 pressurized water reactor (PWR) assemblies in a 143.6-cm-diam cavity, surrounded by a 3.81-cm-thick steel shell, a 10.08-cm lead gamma shield, a 5.08-cm steel shell, a 10.49-cm neutron shield, and a 1.91-cm-thick outer steel barrel. Although approximate and subject to certain caveats, this type of information is useful in estimating what types of fuel may or may not be shipped in a particular cask. The most obvious limitation of the KWIKDOSE program is that it always assumes the neutron shield to be one-third water and two-thirds ethylene glycol, containing a total of 1% natural boron by weight.

14326 **Movement of fossil pore fluids in granite basement, Illinois.** Couture, R.A.; Seitz, M.G. (Argonne National Lab., IL). *Geology;* **14**: No. 10, 831-834(Oct 1986).

The compositions of pore fluids in granite cores from the Precambrian basement in northern Illinois were determined. The estimated chloride concentration in the aqueous phase increases from near zero at the upper contact with sandstone to 2.7 M at 624 m below the contact. Traces of aliphatic oil are present in the overlying sandstone and the upper 516 m of granite, and oil occupies most of the pore space in one sample of unaltered granite 176 m below the contact. The oil has a $\Delta^{13}C$ of -25%, about the same as average petroleum. The high concentrations of salt more than 500 m below the contact imply that little or no fresh water has reached these levels of the granite by flow. Lower concentrations near the contact are consistent with replacement of brine in the sandstone by fresh water at least 11 m.y. ago and subsequent upward diffusion of salt from the granite. Geologic data suggest that the time of replacement was about 130 Ma. The purpose of the investigation is to study the record of movement of intergranular fluids within a granite pluton. The composition and movement of ground waters can determine the extent that hazardous or radioactive wastes disposed in igneous rock will remain isolated.

14327 **Direct oxide reduction: past, present, and future.** Williams, J.D.; Fife, K.W.; Ramsey, H.D.; Bowersox, D.F.; Christensen, D.C.; Austin, L.R. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 341(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The direct oxide reduction (DOR) process was first performed in the early 1960s and converted to a production scale process in about 1980. The process involves the reduction of plutonia (PuO_2) with calcium metal in a calcium chloride solvent. At Los Alamos National Lab. (LANL), many, many individual runs have been made on plutonia batch sizes ranging from 200 to 1200 g. Feeds have varied from very pure reactor source PuO_2 down to foundry source PuO_2 containing < 80% plutonium. The charge size is currently limited by equipment constraints. The solvent capacity of the calcium chloride for calcium oxide is ~ 19 mol% CaO at 850°C. Ultimately, the success of the reduction and collection of a massive metal button depends on solubilizing the generated CaO to maintain a totally liquid system. Similarly, the contribution of oxygen by impurities in the plutonia affects the reduction/collection yield. The rare-earth oxides and other +3 valence state oxides limit the charge size because of their oxygen contribution.

14328 **TRUEX process: a new dimension in management of liquid TRU wastes.** Schulz, W.W.; Horwitz, E.P. *Transactions of the American Nuclear Society;* **52**: 341-442(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The TRUEX process is one of the, if not the, most exciting and potentially useful nuclear separations processes to be developed since the PUREX process was developed and applied in the 1950s. Attesting to its potential widespread use, Rockwell Hanford and ANL investigators, in a joint effort, are developing and testing TRUEX process flow sheets for removal of TRU elements from several Hanford Site wastes including the Plutonium Finishing Plant and complexed concentrate wastes. The TRUEX process also appears to be well suited to removal of plutonium and Am from aqueous chloride wastes generated during plutonium processing operations at the Los Alamos National Lab. (LANL); collaborative efforts between LANL and ANL scientists to develop and demonstrate TRUEX process flow sheets for treatment of LANL site chloride wastes are currently under way.

14329 **Separation of actinides by high-gradient magnetic filtration.** Bruns, L.E.; Schliebe, M.J. *Transactions of the American Nuclear Society;* **52**: 343-344(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

High-gradient magnetic filtration has been identified as a candidate solid/liquid separation technique for removing actinide particulate from waste streams. Although HGMS is not intended to reduce the activity in the waste stream to below 100 nCi/g, it does offer two significant advantages: (a) selective removal of TRU solids for subsequent secondary processing and (b) reduced operating complications during solvent extraction due to solids accumulation in the interfacial region. Removal of > 95 wt% of the plutonium and americium solids is expected regardless of the solids present

and their properties. Verification tests will be performed to validate this assumption.

14330 **Recombiner catalysts for use in TMI-2 core debris shipping canisters.** Bullough, B.D. *Transactions of the American Nuclear Society;* 52: 344-345(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In response to a request from the US Dept. of Energy, Rockwell International's Hanford Operation has evaluated catalytic H_2/O_2 recombiners for use in Three Mile Island Unit 2 (TMI-2) core debris shipping canisters. This catalyst is to be used to minimize pressurization and maintain nonflammable concentrations of hydrogen gas in the closed canisters due to radiolytic decomposition of water in the canisters. The results of this testing program provided a basis for answering several safety and design concerns, including type and amount of catalyst(s) to be used, optimal bed designs, and allowable shipping and storage conditions. The effects of radiation, gas diffusion area limitations, catalyst bed volume requirements, and performance of a mixed-bed catalyst were quantified. The effects of freezing temperatures and various potential catalyst poisons were explored to address concerns about catalyst deactivation by various potential environments.

14331 **Process innovations to minimize waste volumes at Savannah River.** Doherty, J.P. New York, NY; American Institute of Chemical Engineers (1986). 24p. (CONF-860826—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Technical Paper 35C.

The Savannah River Plant (SRP) temporarily stores high-level radioactive waste in underground storage tanks. Approximately 2.85 x 10/sup 5/ cubic meters of waste have evaporated to 1.15 x 10/sup 5/ cubic meters since plant startup in the early 1950's. Sixty percent of the radioactivity is contained in the approximate 10 volume percent stored as alkaline sludge. The remainder of the waste and radioactivity is stored as alkaline salt cake and salt solution. The waste management process development objective for permanent disposal is to concentrate the radioactivity into the smallest practical volume.

14332 **Long-term disposal of radioactive waste - An international issue.** Lakey, L.T. New York, NY; American Institute of Chemical Engineers (1986). 13p. (CONF-860826—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Technical Paper 51A.

Criteria and technology for the long-term disposal of radioactive wastes by deep geologic emplacement are falling into place throughout the international community for the long-term disposal of radioactive wastes. Selection of a site, design of the waste package and repository and evaluation of its performance requires extensive technical analyses and the necessary technical data for use in the analyses. The development of radioactive waste disposal systems requires extensive knowledge of nuclear, chemical and physical principles, the environment and mathematical techniques. The author believes that the development of the technology will ultimately find application in the disposal of non-radioactive hazardous wastes, quickly becoming a major public concern.

14333 **Waste salt disposal at the Savannah River Plant.** Langton, C.A.; Oblath, S.B.; Pepper, D.W.; Wilhite, E.L. New York, NY; American Institute of Chemical Engineers (1986). 24p. (CONF-860826—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Technical Paper 35D.

Waste salt solution, produced during processing of high-level nuclear waste, is incorporated in a cement matrix for emplacement in an engineered disposal facility. Wasteform characteristics and disposal facility details are presented along with results of a field test of wasteform contaminant release and of modeling studies to predict releases.

14334 **Subcriticality measurements for two coupled uranyl nitrate solution tanks using ^{252}Cf-source-driven neutron noise analysis methods.** Mihalczo, J.T.; Blakeman, E.D.; King, W.T. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* 52: 640-642(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The subcriticality of two interacting solution tanks was determined using ^{252}Cf-source-driven neutron noise analysis methods. This work was supported by a program of collaboration between the US Dept. of Energy and the Power Reactor and Nuclear Fuel Development Corporation of Japan to study aspects of nuclear criticality safety related to the development of fast breeder technology. These experiments were the first test of this method for an interacting system with materials (in this case, uranyl nitrate 140 g U/l, 93.15 wt% ^{235}U) typical of nuclear materials in processing plants.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 14210, 14211, 14212, 14213, 14214, 14217, 14224, 14225, 14226, 14229, 14230, 14231, 14232, 14235, 14236, 14239, 14241, 14244, 14245, 14247, 14253, 14257, 14260, 14268, 14279, 14280, 14281, 14282, 14283, 14284, 14288, 14293, 14294, 14295, 14296, 14299, 14300, 14301, 14302, 14303, 14307, 14309, 14315, 14316, 14320, 14321, 14688, 15543

14335 (IPEN-Pub—112, pp 97) **Leaching of nuclear power reactor waste forms.** Endo, L.S.; Villalobos, J.P.; Miyamoto, H. Jul 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88780012/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The leaching tests for immobilized power reactor wastes carried out at IPEN are described. These wastes forms consist mainly of spent resins and boric acid concentrates solidified in ordinary Portland cement. All tests were conducted according to the ISO and IAEA recommendations. Three years leaching results are reported. The cesium diffuvity coefficients determined out of these results are about 1 x 10^{-8} cm^2/s for boric acid waste form and 9 x 10^{-9} cm^2/s for ion-exchange resin waste. Strontium diffusivity coefficients found are about 3 x 10^{-11} cm^2/s and 9 x 10^{-11} cm^2/s respectively.

14336 **(NUREG/CR—4997) Methods for describing airborne fractions of free fall spills of powders and liquids.** Ballinger, M.Y.; Buck, J.W.; Owczarski, P.C.; Ayer, J.E. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 51p. (PNL—6300). NTIS, PC A04/MF A01 - GPO. Order Number TI88004796/JAW.

Pacific Northwest Laboratory developed calculational methods to characterize aerosols produced in hypothetical spill accidents. These methods were developed for the US Nuclear Regulatory Commission to use when evaluating the consequence of postulated accidents for safety analyses and environmental impact statements. Basic physical properties and mechanistic descriptions of spill events were used as a basis for the methods. Source term models consist of equations that can be used to estimate the mass airborne and particle size distribution of aerosols produced by spills of powders and solutions. Experimental data from Sutter et al. (1981) and Ballinger and Hodgson (1986) were emphasized in the models. Parameter ranges for this data were spill height 1 to 3 m, powder mass 25 to 1000 g, and liquid volume 125 to 1000 ml. Liquids spilled included slurries and solutions of varying viscosities. Liquid spills differed from powders in that an aerosol was produced on impact instead of during the fall. The fraction airborne from liquid spills (including viscous solutions and slurries) correlated well with three dimensionless numbers: the Archimedes number, the Froude number, and a density ratio. Liquid aerosol parameters were statistical descriptions of the log-normal distributions. A computer code was developed to model powder spills. In the code, the mass airborne was assumed proportional to the drag force on the power as it falls. The proportionality factor was empirically found

to be a function of a dimensionless number, the Galileo number. 16 refs., 2 figs., 13 tabs.

14337 **(UCID—20514) Plutonium-aerosol emission rates and potential inhalation exposure during cleanup and treatment test at Area 11, Nevada Test Site.** Shinn, J.H.; Homan, D.N. (Lawrence Livermore National Lab., CA (USA)). 13 Aug 1985. Contract W-7405-ENG-48. 16p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88003710/JAW.

A Cleanup and Treatment (CAT) test was conducted in 1981 at Area 11, Nevada Test Site. Its purpose was to evaluate the effectiveness of using a large truck-mounted vacuum cleaner similar to those used to clean paved streets for cleaning radiological contamination from the surface of desert soils. We found that four passes with the vehicle removed 97% of the alpha contamination and reduced resuspension by 99.3 to 99.7%. Potential exposure to cleanup workers was slight when compared to natural background exposure. 7 refs., 1 fig., 2 tabs.

0540 Health And Safety

REFER ALSO TO CITATION(S) 14316, 14336

14338 **(INIS-GB—85) Harwell emergency handbook.** (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Dec 1986. 48p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750945/JAW.

Edited version of AERE-M-3581.

The Harwell Laboratory Emergency Handbook 1987 contains emergency procedures to deal with any incident which might occur at AERE Harwell involving radioactive or toxic material releases. The Handbook gives details of the duties of members of the Site Emergency Organization and other key members of staff, the methods by which incidents are controlled, the communication links and liaison arrangements with other organizations and the possible consequences and actions that may be needed following an emergency.

14339 **(PAEC(C)II-A—86009) Proposed warning scheme for Philippine communities in case of severe radiological accidents in neighbor countries.** de la Paz, L.R. (Philippine Atomic Energy Commission, Diliman, Quezon City). 1986. 8p. (CONF-8608210—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701213/JAW.

From Meeting of action officers of the National Disaster Coordinating Council; Quezon City, Philippines (5 Aug 1986).

The Chernobyl accident in the Ukraine triggered a re-study of the emergency response planning of countries with nuclear power plants as well as those with no plans to put up such plants. As in the Philippines, the proposed early warning system is composed of 1) prompt notification following quidelines established through a bilateral agreement or through an international convention agreed upon by member staes of IAEA, and 2) placement of a continuous radiation monitor in Northern Luzon (Laoag City or Aparri). Early notification network details are given in an illustrated form. The paper also proposes warning classification for the Philippine authorities. (ELC). 3 figs.

14340 **(SAAS—354) Considering the determination of an alpha value.** Lorenz, B. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1987. 20p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700943/JAW.

Following an outline of the most important international methods of evaluating an alpha value (the monetary equivalent of one man-sievert) and an approach deemed suitable for use in the GDR, it is recommended that alpha be taken as 30,000 Mark per man-sievert in national cost-benefit analyses. This value should be revisited every five to ten years.

14341 **Nuclear Protections and Safety Act of 1987. Report of the Committee on Governmental Affairs, United States Senate together with Additional Views to Accompany S. 1085, One Hundredth Congress, First Session.** Washington, DC; Government Printing Office (1987). 51p.

The Senate report on S. 1085 suggests several amendments to the recommended bill which would make oversight of nuclear facility safety an independent board. The legislation responds to concerns that there is no justification for DOE facilities to be exempt from this kind of oversight, and that health and safety standards are as important at nuclear weapons and materials facilities as elsewhere. The report traces the emergence of the nuclear age and the different treatment of government and commercial facilities. There is evidence of a lack of concern for employee health and safety at some government installations. The report summarizes the four titles of the bill, reviews the four days of public hearings, and analyzes the bill by section. It notes changes that will result in the Energy Reorganization Act of 1974, the Atomic Energy Act of 1954, and the Department of Energy Organization Act.

14342 **Initial Q-list for the prospective Yucca Mountain repository based on items important to safety and waste isolation.** Laub, T.W.; Jardine, L.J. (Sandia National Labs., Div. 6311, Nuclear Waste Engineering Projects, Albuquerque, NM 87185). pp 293-300 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC04-76DP00789.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

A method for identifying items important to safety based on a probabilistic risk assessment approach was developed and implemented for the conceptual design of the Yucca Mountain repository. No items were classified as important to safety; however, six items were classified as potentially important to safety. These were the shipping cask, the cranes and the truck or rail-care vehicle stops in the cask receiving and preparation area, the hot cell structure of the waste packaging hot cells, the cranes in the waste packaging hot cells, and the waste-handling building fire protection system. In addition, a method for identifying items important to waste isolation was developed and implemented. Two hydrogeologic units of the Yucca Mountain site were classified as important to waste isolation: the Calico Hills nonwelded zeolitic unit and the Calico Hills nonwelded vitric unit. The preliminary Q-list for the Yucca Mountain repository is comprised of the two units of the site classified as important to waste isolation and contains no items important to safety.

14343 **Radiation doses for a transportation system and its interface operations for commercial spent fuel.** Schneider, K.J.; Smith, R.I. (Pacific Northwest Lab., Richland, WA 99352). pp 405-410 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

This paper gives the results of estimates of aggregated radiation doses to the affected public and workers associated with loading spent fuel at the reactors, transporting the spent fuel by truck and rail, and receiving and unloading the spent fuel at a deep geological repository. The estimates are for a postulated transportation-related system using current state-of-the-art technology, if employed in the high-level waste management system in the future, and the approximate dose reduction from some potential system improvements. The results of the study provide a starting point for the U.S. Department of Energy (DOE) to develop an improved transportation system that is cost effective, safe, and results in low radiation doses.

14344 **Incentives for the allowance of burnup credit in the design of spent nuclear fuel shipping casks.** Sanders, T.L.; Westfall, R.M.; Jones, R.H. (Sandia National Labs., Albuquerque, NM 87185). pp 411-416 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

An analysis has been completed which indicates that the consideration of spent fuel histories ('burnup credit') in the criticality design of spent fuel shipping casks could result in considerable public risk benefits and cost savings in the transport of spent nuclear fuel. Capacities of casks could be increased considerably in some cases. These capacity increases result in lower public and occupational exposures to ionizing radiation due to the reduced number of shipments necessary to transport a given amount of fuel. Additional safety benefits result from reduced non-radiological risks to both public and occupational sectors. In addition, economic benefits result from lower in-transit shipping costs, reduced transportation fleet capital costs, and fewer cask handling requirements at both shipping and receiving facilities.

14345 **A demonstration sensitivity analysis for RADTRAN III.** Reardon, P.C.; Neuhauser, K.S. (Sandia National Labs., Albuquerque, NM 87185). pp 417-422 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

RADTRAN III is a computer code for the assessment of transportation risk. It has been used to conduct risk analyses of radioactive material shipments for the DOE Office of Defense Programs, the DOE Office of Civilian Radioactive Waste Management (OCRWM), and others. These analyses require large amounts of data, and the values of the input parameters influence the magnitudes of the total risk estimates to varying extents. The degree of change in the output (risk) to changes in certain input parameter values is examined here for a small problem from the OCRWM analyses. This paper demonstrates the sensitivity of risk estimates generated by RADTRAN III for a sample problem. Parameters contributing to incident-free and accident risk were analyzed.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 14153, 14318, 14336, 14745

14346 **(CEA-CONF—9043) Measurements of 239 Pu of waste in drums of 200 litres by passive (Gamma, Neutron Counting) and active (14 MeV Pulsed Neutrons) methods.** Bardy, N.; Ruffet, P.; Cance, M. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). May 1987. 7p. (CONF-870519—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751541/JAW.

From 9. annual meeting of the European Safeguards Research and Development Association: safeguards and nuclear material management; London, UK (12 May 1987).

Alpha emitter waste obtained after manufacturing and dismantling are measured by a non destructive assay. All the standard drums (200 litres) are automatically analysed by gamma spectroscopy and neutron coincidence counting; with a new low background station and germanium detector: the threshold of detection in 15 mg of 239 Pu. An active method is also developed by 14 MeV interrogation neutron with a new pulse generator; the calibration curve of this assay system with 239 Pu and light matrice is discussed.

14347 **(IAEA-STR—202) Field testing of near-real-time materials accountancy at the PNC-Tokai reprocessing plant.** Miura, N.; Masui, J.; Komatsu, H.; Todokoro, A.; Iwanaga, M.; Kusano, T.; Komori, Y.; Lovett, J. (International Atomic Energy Agency, Vienna (Austria)). Jan 1987. 66p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700179/JAW.

In 1985 a decision was taken to conduct a joint PNC-IAEA field test under the JASPAS support programme during the 85-2 campaign. The purpose of the field test, as with the earlier internal field test work performed by PNC, was to demonstrate the practicality of near-real-time accountancy using the ten day detection time model and to collect meaningful real data (as contrasted with model data) to evaluate the potential effectiveness of near-real-time accountancy in IAEA safeguards. This report summarizes, discusses and evaluates the data collected, not only during the 85-2 joint field test, but also during all previous campaigns. Chapter 2 gives a description of near-real-time accountancy as it has developed at PNC-Tokai, although the reader is referred to (3) for a more complete description. Chapter 3 reviews the procedures followed in the collection of the data, in particular during the 85-2 campaign joint field test. Chapter 4 presents the raw data collected. Chapter 5 then presents what is here termed an Engineering Evaluation of the data. The discussion in Chapter 5 is directed at a technical understanding of the data and at the resolution of a few identified problems which otherwise limit the usefulness of the data, not at a mathematical evaluation of possible diversion detection. The discussion accordingly is largely qualitative and subjective. Chapter 5 also presents a brief analysis of the data in terms of the running book inventory concept which some have suggested would be simpler and at least adequately effective. Chapter 6 discusses a number of important questions regarding work load, effect of unmeasured inventory fluctuation, data requirement, verification and authentication, and effectiveness of NRTA. Finally, Chapter 7 summarizes the conclusions which can be drawn from the field test work. 6 references.

14348 **(K/ITP—145) Liquid-phase compositions from vapor-phase analyses: 4, Preliminary comparisons of calculations with experimental data on N_2, O_2, F_2, SiF_4, and ClF_3 in UF_6.** Davis, W. Jr. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Nov 1987. Contract AC05-84OT21400. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005257/JAW.

Currently, liquid-phase samples from uranium hexafluoride (UF_6) cylinders are used at all US DOE ^{235}U enrichment facilities to determine the chemical content of cylinders - a requisite in the control and accountability of nuclear materials. Previously published reports note the economic incentives to use vapor-phase sampling for volatile impurities (as a partial replacement for liquid-phase sampling) if the liquid-phase composition can be determined from analysis of vapor-phase samples by using a model of vapor-liquid equilibrium between UF_6 and its common impurities. Such a model was adapted for this purpose in earlier work. Hydrogen fluoride, a common impurity, in UF_6 was shown not to conform to the model although other methods for calculating its concentration in the liquid phase from vapor-phase analyses were presented. This report describes preliminary comparisons with experimental data of model calculations of concentrations of nitrogen, oxygen, fluorine, chlorine trifluoride, and silicon tetrafluoride in liquid UF_6 based on analyses of the vapor phases. 4 figs., 13 tabs.

14349 **(LA—10966-MS) DES [Data Encryption Standard] cryptographic services designed for the DOE Wide Band Communications Network.** Burnham, B. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005084/JAW.

To exchange information between separate facilities of the Nuclear Weapons Complex quickly, accurately, and in computer-readable form, the Department of Energy (DOE) has built a secure data communications facility called the Wide Band Communications Network. The network proper achieves security by using high-grade encryption for the communicaions links and strict physical security measures at the nodes. To provide need-to-know separation among various elements and users of the network, data are encrypted before transmission using the National Bureau of Standards' Data Encryption standard (DES) algorithm. The software described here provides the key management, key distribution, and cipher processing for this network.

14350 **(LA-UR—87-3839) A confirmatory measurement technique for HEU [highly enriched uranium].** Sprinkle, J.K. Jr.; Goldman, A.; Russo, P.A.; Stovall, L.; Brumfield, T.L.; Gunn, C.S.; Watson, D.R.; Beedgen, R. (Los Alamos National Lab., NM (USA); Oak Ridge Y-12 Plant, TN (USA); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 1987. Contract W-7405-ENG-36. 8p. (CONF-871110—17). NTIS, PC A02. Order Number DE88003166/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

Precise measurements of the special nuclear material (SNM) in an item can be used to confirm that the item has not been tampered with. These measurements do not require a highly accurate calibration, but they should be based on an attribute that is unique to the SNM. We describe an instrument that performs gamma-ray measurements at three energies: 185.7 keV, 1001 keV, and 2614 keV. This instrument collects data for 200 s from shipping containers (208-l barrels). These measurements help to distinguish the issue of material control - Has any material been diverted? - from the issue of measurement control - Is there a measurement bias?

14351 (LA-UR—87-4012) Moisture corrections in neutron coincidence counting of PuO_2. Stewart, J.E.; Menlove, H.O. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-871110—16). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004318/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

Passive neutron coincidence counting is capable of 1% assay accuracy for pure, well-characterized PuO_2 samples that contain plutonium masses from a few tens of grams to several kilograms. Moisture in the sample can significantly bias the assay high by changing the (α,n) neutron production, the sample multiplication, and the detection efficiency. Monte Carlo calculations and an analytical model of coincidence counting have been used to quantify the individual and cumulative effects of moisture biases for two PuO_2 sample sizes and a range of moisture levels from 0 to 9 wt %. Results of the calculations suggest a simple correction procedure for moisture bias that is effective from 0 to 3 wt % H_2O. The procedure requires that the moisture level in the sample be known before the coincidence measurement.

14352 (LA-UR—87-4224) A DOE multi-site approach to safeguards integration with facility operations. Ostenak, C.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-871110—15). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004290/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

The Accountability Technology Exchange (ATEX) Working Group was established in October 1986 by the US Department of Energy (DOE) to help identify nuclear materials accountability measurement needs within the DOE plutonium community and recommend potential improvements. ATEX Working Group membership represents nuclear materials production, safeguards, nondestructive assay (NDA), and analytical chemistry at a multitude of DOE plutonium sites. Currently, the ATEX Working Group has identified twenty NDA accountability measurement needs that fall into five major classes: NDA standards representing various nuclear materials and matrix compositions; NDA for impure nuclear materials compounds, residues, and wastes; NDA for product-grade nuclear materials; NDA for nuclear materials process holdup and in-process inventory; and NDA for nuclear materials item control and verification. Specific needs within these classes have been evaluated and ranked for individual sites and for the total DOE plutonium community.

14353 (MLM—3467(OP)) Inherent limitations of fixed-time, servo-controlled radiometric calorimetry. Wetzel, J.R.; Lemming, J.F.; Duff, M.F. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 7p. (CONF-871110—18). NTIS, PC A02. Order Number DE88003432/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

Interest has been shown in using fixed-time, servo-controlled calorimetry to shorten the measurement times for certain samples that require low precision values (3 to 5%). This type of calorimeter measurement could be particularly useful for screening scrap samples to determine whether there is a need for a more accurate measurement or for certain confirmatory measurements for which low precision numbers are sufficient. The equipment required for this type of measurement is a servo-controlled calorimeter and a preconditioning unit. Samples to be measured are placed in the preconditioning unit, which is maintained at the internal temperature of the calorimeter. The power value for the sample is determined at a fixed time after loading into the calorimeter, for example, 30 min. When a calorimeter is operated using a fixed cutoff time, there are additional sources of uncertainty that need to be considered. The major factors affecting the uncertainty of the calorimetry power values are discussed. 2 refs., 4 figs.

14354 (PNL-SA—15414) Inspections as an element of performance evaluations. Smith, B.W. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 19p. (CONF-8711137—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005124/JAW.

From Workshop on material control and accounting for special nuclear materials; Washington, DC, USA (19 Nov 1987).

This paper focuses on the inspection of material accounting as an element of performance evaluations. The role of inspections is to provide an independent assessment that the components of the system are performing at the specified level. To assess performance, measures of performance are needed.

14355 (STI/PUB—722) Nuclear safeguards technology 1986, Volume 2: Proceedings. (International Atomic Energy Agency, Vienna (Austria)). 1987. 635p. (CONF-861104—Vol.2). IAEA, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria. Order Number TI88900321/JAW.

From International symposium on nuclear material safeguards; Vienna, Austria (10 Nov 1986).

Individual papers are processed separately for the data bases. (PSB)

14356 (UCRL—52000-87-10) Energy and Technology Review, October 1987. Lear, R.D.; Altman, W.D.; Crawford, R.B.; de Vore, L.; Gleason, K.; Hendry, D.P.; Kirvel, R.D.; Taft, S.O. (eds.). (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003976/JAW.

This issue reviews the Laboratory's work in security and safeguards. The goals, guidelines, and policies for safeguards and security at all DOE institutions are set at the national level, and the Laboratory actively develops and applies state of the art approaches to meet these national objectives. (JDH)

14357 (UCRL—96685) Transmission-corrected x-ray fluorescence analysis of uranium and plutonium solutions using a dual transmission source. Ruhter, W.D.; Camp, D.C. (Lawrence Livermore National Lab., CA (USA)). 24 Nov 1987. Contract W-7405-ENG-48. 7p. (CONF-871110—14). NTIS, PC A02. Order Number DE88003997/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

The energy-dispersive x-ray fluorescence analysis (XRFA) technique has been implemented at several spent nuclear fuel reprocessing facilities for nondestructive measurements of uranium and/or plutonium concentrations in process streams and product storage tanks. An important factor in these quantitative measurements is the absorption of the fluoresced x-rays by the solution matrix, which must be taken into account to accurately quantify the U or Pu concentrations. We describe a new, accurate method using a dual transmission source of Gd-153 and Co-57 to correct for matrix effects. Results of measurements on uranium and plutonium solution standards show the methodology to be better than 0.5%, which includes statistical precision, over the concentration range from 1 to 250 g/l. 5 refs., 4 figs., 3 tabs.

14358 The Nino Cask-Loading Safeguards System. Fiarman, S. (Brookhaven National Lab., Upton, NY 11973). *Journal of Nuclear Materials Management;* **16**: 412-416(Jul 1987). (CONF-870713—).

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

It is, in general, difficult to determine by means of camera-surveillance techniques what is loaded into spent-fuel casks being prepared for shipment from light-water reactors to other reactors,

reprocessing facilities, or long-term storage. Furthermore, the expected high frequency of cask loadings in the coming years would place too great a burden on the IAEA and Euratom inspectorates if each had to be observed by an inspector. For the case of shipment to other reactors and reprocessing facilities, the casks are soon opened and, in principle, their contents could be ascertained by direct inspection. In the case of long-term-storage facilities, the casks would stay sealed for years, thereby requiring the IAEA to know positively how many spent-fuel assemblies were loaded at the reactor and to have a continuity of knowledge of the cask's contents. It has been proposed instead that the facility operator place the cask seal on the cask within the field of view of a surveillance system linked to the cask seal. This solution, however, may not provide enough credibility for acceptance by the safeguards community. This paper presents an alternative to both inspector presence at cask loading and operator assistance in applying seals; this alternative is called the No Inspector, No Operator system (NINO).

14359 **What are the attributes of a good standard and associated criteria.** Allentuck, J. (Brookhaven National Lab., Upton, NY). *Journal of Nuclear Materials Management;* **16**: 716-720(Jul 1987). (CONF-870713—). Contract AC02-76CH00016.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

The Department of Energy (DOE) Standards and Criteria (S and C) provide the framework upon which Office of Security Evaluations (OSE) inspections of safeguards and security at DOE facilities are conducted. The S and C were created to assure that inspections are comprehensive, standardized to the extent possible and accurately reported in meaningful terms, and that assessments are objective. With these goals in mind, the desirable attributes of a standard and its associated criteria are relevance, inspectability, and limited need for inspector judgment.

14360 **(SAND—87-6005) Mathematical computer models for the analysis of physical protection systems: (Part 2).** Parola, H.C. Translated from *Gendarmeria Nacional ;* **23**: No. 107, 10-12(Jan-Mar 1987). Contract AC04-76DP00789. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005511/JAW.

In the first part of this report, published in issue 105 of this journal, the author states that EASI (Estimate of Adversary Sequence Interruption) is a specific analytical model, leaving open the question of generic models. In this part of the report, the author translates some of the more important aspects of the extensive bibliography on this subject that exists at Sandia Laboratories (Albuquerque, New Mexico, USA) in order to submit them to the consideration of the reading public.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 14173, 14174, 14769, 16175

14361 **(INIS-XN—74) Order of 12 May 1982 on the organisation of activities relating to the nuclear fuel cycle.** (International Atomic Energy Agency, Vienna (Austria)). 18 May 1983. 2p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700669/JAW.

Published in Boletin Oficial del Estado.

The Order provides that electricity utilities must allocate a certain percentage of the funds obtained from the sale of electricity to work on the terminal part of the nuclear fuel cycle. (NEA).

14362 **Hazardous waste regulation for low-level waste: Overview of evolving federal policy.** Sharples, F.E. (Hazardous Waste Remedial Actions Program/ORNL Remedial Action Program, Oak Ridge National Lab., Oak Ridge, TN 37831). pp 460 of Environmental engineering. Dietz, J.D. New York, NY; American Society of Civil Engineers (1987). (CONF-870770—). Contract AC05-84OR21400.

From Specialty conference on environmental engineering; Orlando, FL, USA (6 Jul 1987).

Low-level radioactive waste (LLW) that contains hazardous chemical constituents is now considered to be "mixed waste" and is subject to dual regulation. The federal government's regulatory requirements for mixed waste are complex and still evolving. Three federal agencies have some form of jurisdiction - the Nuclear Regulatory Commission, the Environmental Protection Agency, and the Department of Energy. This paper provides an overview of some of the policy and technical issues involved in the application of hazardous waste regulations to the management of LLW.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

14363 **(INIS-SU—431, pp 531) β sources with iodine isotopes produced in tellurium targets.** Babenkov, M.I.; Zhdanov, V.S.; Starodubov, S.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

14364 **(MLM—3468) Stable isotopes sales: Mound customer and shipment summaries, FY 1985.** Flayler, K.A. (comp.). (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 15 Dec 1987. Contract AC04-76DP00053. 24p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005107/JAW.

A listing is given of Mound's sales of stable isotopes of noble gases, deuterium, carbon, oxygen, nitrogen, chlorine, bromine, and sulfur for fiscal year 1985. Purchasers are listed alphabetically and are divided into domestic and foreign groups. A cross-reference index by location is included for domestic and foreign customers. Cross-reference listings by isotope purchased are included for all customers.

14365 **Cyclotron production of no-carrier-added ^{206}Bi (6.24d) and ^{205}Bi (15.31 d) as tracers for biological studies and for the development of alpha-emitting radiotherapeutic agents.** Lagunas-Solar, M.C.; Carvacho, O.F.; Nagahara, L.; Mishra, A.; Parks, N.J. (California Univ., Davis, USA. Crocker Nuclear Lab.; California Univ., Davis, USA. Lab. for Energy-Related Health Research). *Applied Radiation and Isotopes;* **38**: No. 2, 129-137(1987).

The production and radiochemical purification of no-carrier-added (NCA) bismuth isotopes (i.e. 6.24 d ^{206}Bi and 15.31 d ^{205}Bi) was studied. The Bi isotopes are intended for use as tracers in biodistribution studies and in the design and testing of α-emitting radiotherapeutic agents. The total cross sections and yields for the production of ^{206}Bi and ^{205}Bi from the proton bombardment of natural Pb targets were measured using the stacked-foils technique. A radiochemical method for the separation and purification of NCA Bi radioactivities from a multi-gram Pb target was also tested, modified, and improved to provide aqueous solutions of chemically and biologically useful amounts of NCA sup(206,205)Bi for measuring tissue and subcellular-distributions, and for studies covering several chemical aspects of the development of Pb/Bi-radiotherapeutic agents.

14366 **Strontium-82 production at Los Alamos National Laboratory.** Thomas, K.E. (Los Alamos National Lab., NM, USA). *Applied Radiation and Isotopes;* **38**: No. 3, 175-180(1987).

Strontium-82 has been produced at Los Alamos for almost 10 years using proton-induced spallation of molybdenum metal targets. Irradiations occur at the Los Alamos Meson Physics Facility and chemical processing takes place at the radiochemistry hotcells of the Isotope and Nuclear Chemistry Division. Recent production experience indicates up to 20-30 Ci of ^{82}Sr may be produced from a single target in a one-month irradiation. Strontium-85 is also present in the product in amounts roughly equal to ^{82}Sr (at the end of bombardment). Several chemical separation processes have been used during this time, mostly involving ion exchange and solvent extraction methods. In this paper, the most recent separation method, using cation exchange chromatography with α-hydroxyisobutyric acid, will be discussed.

14367 **Production of ^{85}Sr by proton irradiation of RbCl.** Mausner, L.F.; Prach, T.; Srivastava, S.C. (Brookhaven National Lab., Upton, NY, USA). *Applied Radiation and Isotopes;* 38: No. 3, 181-184(1987). Contract AC02-76CH00016.

The production of ^{85}Sr from proton irradiation of natural RbCl targets has been investigated. Protons of 84-51 MeV from the Brookhaven Linac Isotope Producer have been used to prepare up to 24.2 GBq of ^{85}Sr per target. Chemical isolation of Sr was accomplished with ion exchange on Chelex 100 with an average recovery of 83%. At shipment the $^{89}Sr/^{85}Sr$ ratio was <0.05 and the $^{85}Sr/^{83}Sr$ ratio was <0.75.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 15499

14368 **(INIS-BR—748, pp 91) Characterization of beta radiation range of a source for industrial application.** Caldas, L.V.E.; David, J. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil; Institut fuer Strahenschutz, Stohl, Germany, F.R.). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14369 **(PB—88-854872/XAB) Corn starch: properties and processing. January 1972-December 1987 (citations from the Food Science and Technology Abstracts data base). Report for January 1972-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 180p. NTIS PC N01/MF N01.

Supersedes PB—87-850301.

This bibliography contains citations concerning corn starch processing. The physical and chemical properties, and nutritive value of corn starch and corn starch products are considered. Studies of gamma-irradiated corn starch are included. (This updated bibliography contains 397 citations, 123 of which are new entries to the previous edition.)

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 13917, 14408

14370 **(BNL—40547) Thermogravimetric analysis of polymeric materials for an intermediate temperature solid electrolyte.** Linkous, C.A.; Wade, T. (Brookhaven National Lab., Upton, NY (USA)). Oct 1987. Contract AC02-76CH00016. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004854/JAW.

Weight-loss thermograms under atmospheres of N_2, H_2, and O_2 were taken for 39 polymeric candidate materials for use in an intermediate temperature (300 to 600°C) electrolyte. Selected materials were also tested under a steam atmosphere. The following materials showed sufficient stability as to warrant further study: polyimide; polyamide; polymers of pyrrolidone, pyridine, and imidazoline; phthalocyanine; polyethylene glycol and polyvinylmethyl ether. Polyacrylonitrile and polyphenylene sulfide, while exhibiting a limited performance here, show enough potential that further attention should be given to them also. Studies on the stability of various ionomers indicated that simple acidic oxo-anions such as sulfonate and carbonate are unsuitable for use as proton binding sites in the desired temperature range.

14371 **(PB—88-142195/XAB) Mechanisms of water-gas shift catalysis. Topical report, October 1986-June 1987.** Lilga, M.A.; Camaioni, D.M.; Elliott, D.C.; Hallen, R.T.; Robertus, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. 53p. NTIS, PC A04/MF A01.

Catalysis of the water-gas shift reaction in aqueous base solution was studied. Evaluation of the literature indicates that the catalytic cycle most likely involves formate synthesis and formate decomposition pathways. Below 350°C, formate synthesis is rapid and formate decomposition appears to be rate limiting. Above 350°C formate decomposition is fast. At 300°C, an approximate first-order dependence in base is observed. Hydrogen production is up to 37 times faster in the presence of Na_2CO_3 compared to the uncatalyzed reaction. Alkali-metal carbonates are about an order of magnitude more active than alkaline-earth carbonates under identical conditions. Anion effects appear to be minimal especially under equilibrium conditions. Nonbasic salts such as NaCl and Na_2SO_4 also enhance H_2 production suggesting that the cation may promote formate decomposition.

0802 Storage

REFER ALSO TO CITATION(S) 15562

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 13924, 14776, 14845

14372 **(DOE/PC/80015—T2) Reactions of selected 1-olefins and ethanol added during the Fischer-Tropsch synthesis: Topical report.** Hanlon, R.T.; Satterfield, C.N. (Massachusetts Inst. of Tech., Cambridge (USA)). 30 Oct 1987. Contract AC22-85PC80015. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003187/JAW.

The effects of addition during synthesis of C_2, C_4, C_8, C_{10} or C_{20}, normal 1-olefins, was studied in a continuous well-stirred liquid phase reactor. Studies were at 248°C and 0.78 to 1.48 MPa, using a reduced fused magnetite catalyst containing potassium. Incorporation of these olefins into growing chains could be detected, but was relatively minor. Instead the olefin was hydrogenated to the corresponding paraffin or isomerized to the 2-olefin. Excluding ethylene, which is unusually reactive, the reactivity of the olefins increased with molecular weight. Disappearance of all added species was much less at low synthesis conversions than at high, attributed to competitive adsorption with CO. The reactions of added ethanol were also studied. Ethanol or ethylene decreased the hydrogenation capabilities of the catalyst as reflected in decreased formation of CH_4 and increased olefin/paraffin ratio of the products. Neither addition affected the chain growth probability, α. 21 refs., 11 figs., 5 tabs.

14373 **(NEI-DK—60) Demonstration projects for utilization of biogas. Status report.** (Crone og Koch Raadgivende Ingenioerfirma K/S, Viborg (Denmark)). Sep 1986. 134p. (In Danish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751147/JAW.

The purpose of the report is to get a view of the ongoing investigations of setting up demonstration projects for the utilization of biogas. The biogas potential would cover 18% of energy consumption in these areas, which do not receive combined power and heat, district heating or natural gas. Out of this potential biogas from agriculture would be able to supply most of this (78%), which could be used in 500-600 plants. Biogas from municipal waste makes 11%. The technical possibilities of connecting biogas and natural gas in the distribution system are evaluated. The report discusses organization of projects, financing of the demonstration plants, the policy of pricing, and contains a description of specific projects. The report concludes that there are several advantages of utilization of biogas, economic as well as environmental. (SM). 16 refs. Prepared for Naturgas Midt/Nord I/S.

14374 **Studies on the mechanism of ethylene hydrogenation over iridium (111) single crystals.** Lloyd, J.T. Ames, IA; Iowa State Univ. (1987). 118p. University Microfilms Order No. 87-21,906.Contract W-7405-ENG-82.

Thesis (Ph.D).

The kinetics of ethylene hydrogenation on iridium (111) single crystals were measured in the temperature range of 312K to

625K. The pressure of hydrogen was varied from .4 to 626 torr and the pressure of ethylene was varied from .08 to 588 torr to determine the kinetic order of each reactant at 473K. The hydrogen kinetic order was determined to be 1. The ethylene kinetic order varied from 1 at low pressures to 0 at higher pressures. The data were fit to a Langmuir Hinshelwood mechanism. The temperature dependence of ethylene hydrogenation yielded an activation energy of 12.5 Kcal/mole between 312K and 400K. A maximum in the temperature versus rate plot is attributed to a change in the form of the adsorbed ethylene which is hydrogenated on the surface. Thermal desorption and Auger electron spectroscopies supported this argument by providing additional information on the nature of partially hydrogenated carbonaceous surface species on the surface after ethylene hydrogenation. The yield of side product, methane, was determined under the same conditions as the hydrogenation reaction. Methane was observed to originate from ethylene and not hydrogenolysis of the hydrogenation product, ethane. The quality of the data did not allow accurate determination of the orders for methane formation. The activation energy is 4.88 kcal/mole.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 14110

14375 (DOE/ID/12187—T1) Kentucky Agricultural Energy Corporation 21-million gallon per year fuel-ethanol plant: Final report. (Kentucky Agricultural Energy Corp., Franklin (USA)). Nov 1987. Contract FC07-81ID12187. 327p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE88005199/JAW.

This report describes the design, construction, start-up, and operation of the 21-million gallon per year ethanol facility built by KAEC in Franklin, Kentucky. Built from the ground up, the plant construction began at the 180-acre plant site on November 3, 1980. The first alcohol was produced on December 20, 1982. The plant is a dry milling fermentation facility. The plant also manufactures as co-products distillers dried grain with solubles (DDGS) at approximately 70,000 tons per year, and carbon dioxide at approximately 70,000 tons per year. The plant consumes 8 million bushels per year of yellow shelled corn. The actual operating data in this report are based on the four-month operating period of July, August, September, and October 1986. During this production period the plant averaged 103%, 88%, 105%, and 105% of design capacity for each month, respectively. This report will compare the design operation and economics with actual performance.

14376 (ETSU-R—44) Assessment of bio-ethanol as a transport fuel in the UK. Marrow, J.E.; Coombs, J.; Lees, E.W. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Oct 1987. 144p. H.M. Stationery Office, London, price Pound 17.50.

The technical and economic issues associated with the production of bio-ethanol as a road transport fuel (fuel ethanol) in the UK are assessed. This volume addresses the current situation (May 1987) and covers the production of bio-ethanol from available raw materials using technology that is well established on an industrial scale, as well as the use of ethanol-petrol blends in existing petrol engines.

14377 (NP—8751666) Model of the carburetor fuel and chemistry sector. Bremen, L. von. (Bundesforschungsanstalt fuer Landwirtschaft, Braunschweig (Germany, F.R.). Inst. fuer Landwirtschaftliche Marktforschung). Sep 1986. 81p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751666/JAW.

In the context of the energy economy situation of West Germany, an estimate is to be made of the sales potential for energy from biomass, particularly ethanol. The survey handed over to the West German Ministry of Food Agriculture and Forestry in June 1986 contains four chapters. The first three chapters are of an argumentative character. They contain the basic information and its analysis. The fourth chapter reproduced in this work report contains the methodical sections of the work. The instruments used for analysis are first introduced. This is a multiperiod sector process analysis model with dynamic and mixed integer components, which can be handled using a matrix generator progam developed during the work and various smaller software components on the FAL computer. The results of the calculations show that the use of ethanol for producing fuel would be below the present market price for ethanol in a free market. The alternatives worked out also show to what extent the transition to lead-free petrol would result in an increased crude oil consumption due to changed conversion coefficients. The occurrence of co-products depends on the scenario. One must expect that the transition to lead-free fuel and fuel containing ethanol would lead to changed supply structures in the co-product markets with corresponding effects on the price level. In a final discussion, the possibilities of including changes of extra-economic circumstances in the simulation are discussed.

14378 Deactivation of catalysts in biomass gasification. Brown, M.D.; Baker, E.G.; Mudge, L.K. New York, NY; American Institute of Chemical Engineers (1986). 22p. (CONF-860826—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Technical Paper 20D.

Current research in the gasification of biomass materials includes production of a methanol synthesis gas catalytically. The function of the catalyst is to promote the decomposition of the methane, higher gaseous hydrocarbons, and tars and oils. Previous experiments have indicated early deactivation of catalysts due primarily to carbon deposition. This paper discusses efforts to model the heat and mass transfer within porous catalyst pellets during secondary gas phase gasification reactions. Experimental data for both fixed and fluid bed biomass gasifiers are presented which support the conclusions drawn above.

0903 Inorganic Hydrogen Compound Fuels

REFER ALSO TO CITATION(S) 16114

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 14777, 14778, 14863

14379 (NEI-NO—16, pp 12) Fuel briquets from waste. Hansen, B.V. (Soendre Vestfold Avfallsselskap, Larvik Norway). 9 Dec 1986. (In Norwegian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751113/JAW. (CONF-8612116—).

From Seminar on utilization of energy and biogas from waste deposits; Sandefjord, Norway (9 Dec 1986).

The lecture deals with a refuse pelletizing plant for fuel production at Larvik (Norway). The annual production capacity is about 10000 tons. Building and operating costs are given. A discussion on the production processes and equipment, and marketing conditions for such type of fuels are presented. The fuel demand for the drying processes is mainly covered by biogas from a landfill gas production plant in the neighbourhood. A combined oil/gas heater is installed. 3 drawings.

14380 (NYSERDA—87-26-Vol.1) Performance monitoring of advanced technology wood stoves: Field testing for fuel savings, creosote buildup and emissions: Volume 1, Final report. (OMNI Environmental Services, Inc., Beaverton, OR (USA)). Nov 1987. 321p. NYSERDA, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI88900303/JAW.

This report presents the results of a two-year study in Vermont and New York monitoring woodstove performance. The objective of the study was to determine the effectiveness of catalytic and non-catalytic low-emission woodstove technology in reducing wood use, creosote and particulate emissions. Measurements of wood use and creosote accumulation in chimney systems were made in a total of 68 homes over a period of two heating seasons. Forty-two of these homes were equipped with instrumentation to measure particulate emissions and directly-measured wood use. Catalytic woodstoves, catalytic add-on/retrofit devices and non-

catalytic low-emission stoves were provided by various woodstove manufacturers for use by volunteer homeowners during the study period. Conventional technology stoves were also included to provide baseline data. Averaged results indicate that the low-emission non-catalytic stoves and catalytic stoves had lower creosote accumulation, wood use, and particulate emissions than the conventional technology stoves, although the range of values was quite large. The reductions in particulate emissions by the catalytic and low-emission stoves were not as great as could be expected based on laboratory testing. The large number of variables affecting stove performance in "real world" conditions make identifying causative factors difficult. Additional analysis of data and further testing are currently planned. 5 refs., 61 figs., 23 tabs.

14381 **(PB—88-117247/XAB) Wyoming and western South Dakota's 1983 fuelwood harvest. Forest Service resource bulletin.** McLain, W.H. (Forest Service, Ogden, UT (USA). Intermountain Research Station). Sep 1987. 14p. (FSRB/INT—47). NTIS, PC A03/MF A01.

The estimated fuelwood harvests in Wyoming and western South Dakota in 1983 were 143,000 cords (10 million cubic feet) and 46,000 cords (3.5 million cubic feet), respectively. In Wyoming, the fuelwood harvest volume was one-third the volume of sawlogs and other industrial roundwood products harvested. In western South Dakota, the fuelwood harvest volume was 15% of the industrial roundwood. Survey participants were commercial operators and households.

0906 Gaseous Waste Fuels

REFER ALSO TO CITATION(S) 14426

14382 (NEI-NO—16, pp 18) **Gas from the Grinda waste plant. Operation and maintenance.** Lunde, T. (Soendre Vestfold Avfallsselskap, Larvik Norway). 9 Dec 1986. (In Norwegian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751113/JAW. (CONF-8612116—).

From Seminar on utilization of energy and biogas from waste deposits; Sandefjord, Norway (9 Dec 1986).

The lecture deals with enhancement techniques for a landfill gas production plant at Larvik (Norway). The existing gas yields and the constituents of gas together with the safety systems, process control systems, and process equipment are given. The development of accelerated gas production by scaling up the processes to a full-size operational landfill within a period of two years are presented. 4 drawings, 2 tables.

13 HYDRO ENERGY

14383 **(DOE/ID/12127—1) Small-Scale Hydroelectric Power Demonstration Project: City of Paterson, Great Falls Hydroelectric Project: Final technical and construction cost report.** (Halliwell Associates, Inc., East Providence, RI (USA)). Dec 1987. Contract FC07-80ID12127. 123p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004164/JAW.

A final report is presented for a small scale hydroelectric demonstration project in Paterson, New Jersey. The project consisted of retrofitting an existing dam and structure to adapt them for use as a modern hydroelectric generating facility. This report summarizes project activities, including the project feasibility and planning process, project management, construction, technical design, and cost.

1301 Resources And Availability

REFER ALSO TO CITATION(S) 14386, 14387, 14767

1303 Plant Design And Operation

14384 **(STF—67A86022) Innset power station. Thermodynamic efficiency measurements. Loss of fall in the water tunnel.** Hulaas, H. (SINTEF, Trondheim (Norway)). Nov 1986. 82p. (In Norwegian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751120/JAW.

The report deals with an evaluation of thermodynamic efficiency and loss of fall at a hydroelectric power station. The measuring methods and test results together with the calculation methods are discussed and presented. The turbine efficiency is found to be 93,3 % with an output of 36 MW. The loss of fall values in respect of various discharges are given. 13 drawings, 4 tables.

1306 Environmental Aspects

14385 **(AD-P—005688/7/XAB) Federal Energy Regulatory Commission dam-safety program.** Foster, J. (USDOE Federal Energy Regulatory Commission, Washington, DC). Jan 1987. 27p. NTIS, PC A03/MF A01.

This article is from Proceedings of REMR (Repair, Evaluation, Maintenance, and Rehabilitation Research Program) Workshop on Assessment of the Stability of Concrete Structures on Rock Held in Vicksburg, Mississippi on 10-12 September 1985, AD-A185 644, 62-88.

The Federal Energy Regulatory Commission (FERC), Office of Hydropower Licensing, is responsible for the regulation of nonfederal hydroelectric power projects. All hydroelectric facilities not owned and operated by a federal agency, such as the Corps of Engineers, TVA or USBR, must obtain an operating license from FERC. The Federal Power Act, first enacted in 1920, gives FERC broad powers to insure public safety and proper utilization of water resources for hyroelectric power generation. FERC currently has jurisdiction over approximately 2200 hydroelectric projects involving approximately 790 dams over 35 feet in height and, therefore, has a keen interest in the safety of existing dams. The dam-safety program at FERC is administered in two ways. First, all projects for which an application for license is received, or for which a major change in development is proposed, must be certified as safe and adequate by Design Review Branch (DRB) Engineers.

14386 **(CONF-8708124—1) Cumulative impact assessment: Application of a methodology.** Witmer, G.W.; Bain, M.B.; Irving, J.S.; Kruger, R.L.; O'Neil, T.A.; Olsen, R.D.; Stull, E.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003052/JAW.

From Water power '87; Portland, OR, USA (9 Aug 1987).

We expanded upon the Federal Energy Regulatory Commission's (FERC) Cluster Impact Assessment Procedure (CIAP) to provide a practical methodology for assessing potential cumulative impacts from multiple hydroelectric projects within a river basin. The objectives in designing the methodology were to allow the evaluation of a large number of combinations of proposed projects and to minimize constraints on the use of ecological knowledge for planning and regulating hydroelectric development at the river basin level. Interactive workshops and evaluative matrices were used to identify preferred development scenarios in the Snohomish (Washington) and Salmon (Idaho) River Basins. Although the methodology achieved its basic objectives, some difficulties were encountered. These revolved around issues of (1) data quality and quantity, (2) alternatives analysis, (3) determination of project interactions, (4) determination of cumulative impact thresholds, and (5) the use of evaluative techniques to express degrees of impact. 8 refs., 1 fig., 2 tabs.

14387 **(CONF-8708189—1) Cumulative impact assessment: Issues to consider in selecting a cumulative assessment method.** Stull, E.A.; Bain, M.B.; Irving, J.S.; LaGory, K.E.; Olsen, R.D.; Witmer, G.W. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88002859/JAW.

From International conference on hydropower; Portland, OR, USA (19 Aug 1987).

Because widespread interest in the subject is new, there are no standard or generally recognized methods for cumulative impact assessment. A method should include procedures for (1) evaluating the combined effects of more than one action, (2) evaluating nonadditive, as well as additive, relationships between projects, (3) assessing the combined indirect effect of projects on fish and wildlife populations, in addition to direct effects on the physical environment and fish and wildlife habitats, and (4) assessing any of the 16 types of impacts to 40 species of fish and wildlife.

14388 **(DOE/BP—899) Improving hatchery effectiveness as related to smoltification.** (USDOE Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife). May 1987. 257p. (CONF-8505378—). NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88003264/JAW.

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

The Bonneville Power Administration (BPA) intends to develop a smoltification research effort that would have broad support among the interested parties. BPA sponsored this workshop on smoltification and related research to gather leading technical experts in the field in smoltification, permit them to exchange information about the state of the art of smoltification research, and allow them to identify and rank high-priority projects. This document includes keynote speeches, technical papers, and other sessions that summarize both what is known and what information is needed.

14389 **(EPRI-AP—5480) Turbine-related fish mortality: Review and evaluation of studies: Final report.** Eicher, G.J. (Eicher Associates, Inc., Portland, OR (USA)). Nov 1987. 186p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920080/JAW.

This project collected, listed and reviewed past studies of turbine-related fish mortality and from the review qualify evaluation findings and their implications in fish passage improvement. Included were 64 reports of turbine passage investigations at specific sites. Thirty-six papers reviewing turbine mortality aspects in general, but not of individual plants, were also studied, as were 56 study reports of subjects related to turbine mortality, such as turbine design, cavitation, gas supersaturation, pressure, descaling and shear. Annotated bibliographies for these three groups are provided, as is a glossary of terms used in this work. Hydraulic turbines are described with particular reference to routes of fish through them in relation to assumed zones of fish damage. Methods and purposes of assessing such damage as well as factors affecting accuracy are discussed. Detailed critiques of the turbine passage studies examined include reasons for the studies, types of studies, methods, execution, and results. The only relatively clear linkage with mortality was that of peripheral runner speed in the case of Francis units. Tubine model studies indicate influences of tailwater level, cavitation, wicket gate opening, and speed at which fish strike turbine blades. Injury types do not provide clear evidence of their source.

14390 **(TVA/ONRED/AWR—87/41) Effects of aeration and minimum flow enhancement on the biota of Norris tailwater.** Yeager, B.L.; Seawell, W.M.; Alexander, C.M.; Hill, D.M.; Wallus, R. (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Jul 1987. 100p. NTIS, PC A05/MF A01. Order Number DE88900175/JAW.

In the Clinch River in east Tennessee, releases from Norris Dam had dissolved oxygen (DO) concentrations as low as 1 mg/L. TVA Launched a Reservoir Releases Improvement Program in 1980 to increase DO during the warmer months of the year and to provide a minimum flow in the Norris Dam tailwaters. Turbine venting increased minimum DO in the releases by 0.7 mg/L in 1981 and 2-3 mg/L in 1982-1985. A flow reregulation weir was installed in 1984 two miles below Norris Dam and provides a minimum flow of 200 cfs downstream. This report details the effects of aeration, increased minimum flow, and other factors on the trout fishery and macroinvertebrates of Norris tailwater. As a result, fishing effort, catch rate and harvest of trout increased significantly during the past 5 years; more stable and aesthetically pleasing flow conditions were established, and the State of Tennessee maintained a strong trout stocking program to meet the increased popularity of the stream following TVA efforts to improve fishery conditions. While aeration has improved the condition (plumpness) of trout somewhat during late summer and fall, the fish continue to show some effects of stress when DO levels fall below about 6 mg/L. 23 refs., 12 figs., 27 tabs.

14391 **National perspective on environmental constraints to hydroelectric development.** Hildebrand, S.G.; Sale, M.J.; Cada, G.F.; Loar, J.M. (Environmental Sciences Div., Oak Ridge National Lab., Oak Ridge, TN). pp 301-303 of Perspectives on nonpoint source pollution. Washington, DC; U.S. Environmental Protection Agency (1985). (CONF-8505148—; EPA—440/5-85-001).

From National conference on perspectives on nonpoint source pollution; Kansas City, MO, USA (19 May 1985).

The U.S. Department of Energy (DOE) initiated a hydropower development program in 1977 to promote small-scale (≦30 MW) hydroelectric projects across the country. The Environmental Sciences Division at Oak Ridge National Laboratory implemented studies on the environmental effects of hydropower development in 1978 in support of the DOE effort (Hildebrand and Grimes, 1979). This paper summarizes analyses of two issues that relate to the general theme of this conference: problems associated with the concentration of dissolved oxygen in tailwaters below dams and instream flow requirements for fisheries. In addition, the need for and technical challenges related to assessment of the environmental effects of multiple-project development in river basins are discussed.

1307 Power-conversion Systems

14392 **(STF—16A84133) Results from an investigation on rust nodules at the Hafslund power station, Sarpsborg, 1984-09-03.** Steinsmo, U. (SINTEF, Trondheim (Norway)). Dec 1984. 35p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751184/JAW.

The report deals with an investigation on the corrosive effects from limnetic bacteria for the hydroelectric power plant intake structures. The effects were found to be corrosion tubercles and fouling. Anti-corrosive treatment methods are also discussed. 1 drawing, 5 tables.

14393 **(STF—16A84136) Results from an investigation on rust nodules at the Tokke power station, Dalen, 9 October 1984.** Steinsmo, U. (SINTEF, Trondheim (Norway)). Dec 1984. 29p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751118/JAW.

The report deals with an investigaton on the corrosive effects from limnetic bacteria for the hydroelectric power plant intake structures. The effects were found to be corrosion tubercles and fouling. Anti-corrosive treatment methods are briefly discussed. 5 tables.

14 SOLAR ENERGY

14394 **(INIS-BR—748, pp 189) Solar cells project/INPE-Activities for the biennium 86/87.** Nubile, P. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14395 (LA—11128-SR) Los Alamos optical materials reliability, maintainability, and exposure testing program: 1985 data report. Moore, S.W. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001953/JAW.

This report presents observations of solar collector materials exposed to the environment. Data presented are gathered as part of an ongoing investigation described in earlier reports. 3 refs., 17 figs., 12 tabs. (JDH)

14396 (LBL—23386) Thermal and solar-optical properties of silica aerogel for use in insulated windows. Hartmann, J.; Rubin, M.; Arasteh, D. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 8p. (CONF-870711—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004570/JAW.

From Solar '87: 12th national passive solar conference; Portland, OR, USA (12 Jul 1987).

Silica aerogel is a porous insulating material that is transport to solar radiation. To understand its insulating performance in a window system, it is necessary to first study component heat transfer paths. Aerogel's absorption coefficient, a measure of the attenuation of radiation heat transfer, was determined over the spectral range 1-200 μm. Although radiation heat transfer is negligible over much of this region, there is a transmission window between 3-6 μm. At ambient temperatures, for aerogel thicknesses of 0.5-5.0 cm, radiation heat transfer through an unmodified aerogel window is less than 15% of the total heat flux. For evacuated or high-temperature furnace windows, this contribution can be over 50%. Thermal radiative transfer can be somewhat decreased by allowing the aerogel to absorb moisture, but solar transmission and optical clarity are sacrificed. Absorption of water vapor over time causes irreversible structural changes that increase scattering in the solar spectrum. Aerogel's thermal performance can be improved by replacing the pore gas with one of lower conductivity or by evacuating the aerogel to pressure below 0.1 atm. A hypothetical evacuated aerogel window has a calcuated U-Value of ≈0.5 W/m^2-K for a gap spacing of 12.5 mm, which is four times better than currently available low-emissivity gas-filled units of similar size. 8 refs., 9 figs.

1401 Resources And Availability

14397 (DOE/CH/10200—T4) Satellite techniques of solar resource assessment for focusing and non-focusing solar collector systems: Technical progress report. Justus, C.G. (Georgia Inst. of Tech., Atlanta (USA). School of Geophysical Sciences). Mar 1986. Contract FG02-84CH10200. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004183/JAW.

This paper discuases experimental measurements performed to verify a mathematical model used to predict solar insolation from satellite data. Measurements were taken at ground station in Saudi Arabia and the data are compared to estimates made using METEOSAT data. 3 refs., 10 figs. (JDH)

14398 Spectral solar irradiance data and instrumentation for PV device measurements and analyses. Riordan, C.J.; Cannon, T.W.; Hulstrom, R.L. (Solar Energy Research Institute, Golden, CO). pp 160-165 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Spectral solar irradiance models and data are needed to model, design, and predict the performance of photovoltaic (PV) devices, which are spectrally selective. The approach taken by SERI's Resource Assessment and Instrumentation Branch to address this need is to improve spectral solar irradiance models and measurement techniques while cooperating with the PV community to build a spectral solar irradiance data archive for different climates. These models and data are incorporated in PV device models to study the sensitivity of selected PV devices to variations in spectral irradiance. The objective is to improve the understanding of the relationships between variations in spectral irradiance and the performance of PV devices.

1403 Economics

REFER ALSO TO CITATION(S) 14825

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 14373, 14378, 14398, 14710, 14779, 14785, 14794, 15165, 15168, 15237, 15258, 15360, 16127, 16136, 16183

14399 (BMFT-FB-T—86-226) Systems for the utilization of solar, wind and biogas energy in the PR of China. Phase 2. Project biogas plants. Final report. Loll, U.; Pawletta, G.; Reinert, D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Loll (U. Dr. Ing.) Abwasser- und Abfalltechnik, Darmstadt (Germany, F.R.)). Dec 1986. 84p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751657/JAW.

The German-Chinese cooperation programme focuses on the further development of systems for the utilization of alternative energy sources, e.g. solar, wind, and biogas energy, based on know-how transfer and with the aim to improve the technical knowledge of both partners. Biogas plants of different design were constructed in the pilot village of Yihezuang in the Daxing district near Bejing. The technology of the plants shows different degrees of sophistication, so that the plants will be variable enough for different sites. The test and measurement phase will continue through 1986. With 2 tabs., 82 figs..

14400 (CONF-8610376—Summs.) Higher plant mitochondrial DNA: Genomes, genes, mutants, transcription, translation. (International Society for Plant Molecular Biology, Athens, GA (USA)). 1986. Contract FG09-86ER13561. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005012/JAW.

From International workshop on higher plant mitochondrial DNA: genomes, genes, mutants, transcription, translation; Airlie, VA, USA (19 Oct 1986).

This volume contains brief summaries of 63 presentations given at the International Workshop on Higher Plant Mitochondrial DNA. The presentations are organized into topical discussions addressing plant genomes, mitochondrial genes, cytoplasmic male sterility, transcription, translation, plasmids and tissue culture. (DT)

14401 (DOE/BP/17609—1) Harvesting overstocked stands of small diameter trees: Report No. 1: Stem density of western hemlock, Douglas-fir and western redcedar. Pong, W.Y.; Waddell, D.R. (Forest Service, Portland, OR (USA). Pacific Northwest Research Station). 15 Mar 1985. Contract AI79-84BP17609. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003747/JAW.

This report presents results from a stem density (wood and bark combined) study conducted on trees from overstocked mixed conifer stands of Douglas-fir (Pseudotsuga menziesii), western hemlock (Tsuga heterophylla) and western redcedar (Thuja plicata) located on the Quilcene Ranger District, Olympic National Forest in the State of Washington. Information on the density of stem wood that is available in literature generally have been derived from trees growing in stands of normal stocking levels. Stem densities, an essential parameter in the determination of stem biomass, have not been investigated for trees growing in overstocked conditions. Predictive estimators of density based on data derived from studies of normally stocked stands can not be applied to trees growing in an overstocked condition with any reliability. There is need to specifically examine stem densities in trees grown under these adverse conditions. 3 refs., 3 tabs.

14402 (DOE/BP/17609—2) Harvesting overstocked stands of small diameter trees: Report No. 2: Biomass distribution in western hemlock, Douglas fir, and western redcedar. Pong, W.Y.; Waddell, D.R. (Forest Service, Portland, OR (USA). Pacific Northwest Research Station). 30 May 1986. Contract AI79-84BP17609. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003746/JAW.

This report presents results from a study characterizing the weight and volume of trees from overstocked (doghair) mixed conifer stands of Douglas-fir (Pseudotsuga menziesii), western hemlock (Tsuga heterophylla) and western redcedar (Thuja plicata) located on the Quilcene Ranger District, Olympic National Forest. There are approximately 20,000 acres classed as doghair on the Quilcene District. In order to evaluate their harvesting and utilization potential accurate estimates of volume and weight of entire trees and stands are needed. The objective of this study was to characterize the biomass of the three major tree species located in overstocked stands by providing estimators to predict the green and dry weight of the total tree, as well as separate predictions for the components of stem and crown. Additional objectives included estimates for the weight of the 'standing dead', the weight of the dead material on the forest floor, and estimators to predict the cubic volume of the wood and bark in the stems. 11 refs., 9 figs., 15 tabs.

14403 (DOE/BP/17609—3) Harvesting overstocked stands of small diameter trees: Report No. 3: Chemical composition and implications for harvest strategy. Little, S.N.; Waddell, D.R. (Forest Service, Portland, OR (USA). Pacific Northwest Research Station). 7 Jul 1986. Contract AI79-84BP17609. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003745/JAW.

This study looked at an isolated portion of the doghair problem: nutrient capital and deficiencies of overstocked sites at Quilcene, Washington. We found nutrient capital and availability to be sufficient for tree growth on these sites. Productivity in terms of optimal product development seems to be primarily a stocking control problem. The results of this study provide an insight into management implications of whole tree harvesting of these stands. Because the nutrient capital in living crown materials comprises a small portion of the total site capital, extracting this material from the site during harvest or site preparation activities should not pose a threat to biomass production. When prescribing harvest and site preparation methods, consideration should be given to the amount of nutrient capital which is currently tied up in dead material and in the forest floor. Likewise, attention should be paid to the effects that management practices may have on the soil physical properties. 32 refs., 8 figs., 10 tabs.

14404 (DOE/BP/17609—5) Harvesting overstocked stands of small diameter trees: Report No. 5: Energy value of whole-trees and crowns. Howard, J.O. (Forest Service, Portland, OR (USA). Pacific Northwest Research Station). 1 Jul 1987. Contract AI79-84BP17609. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003743/JAW.

The objective of the study was to determine the higher heating value of whole-tree chips and crown materials for species being harvested in the doghair stands on the Quilcene Ranger district, Olympic National Forest. Values, in terms of Btu's per oven dry pound, were derived for the three major species occurring in these stands: western hemlock, Douglas-fir, and western redcedar. Hogfuel derived from these stands comes from whole-tree chipping and crown materials created during the delimbing/debarking process. Since hogfuel may be created separately from these two sources it is important that their energy values are known. Separation of species is not done during whole-tree chipping, thus a composite value of hogfuel from this source was determined. 6 refs., 1 tab.

14405 (DOE/CE/15270—T4) Explorations of mechanisms regulating ectomycorrhizal colonization of boron-fertilized pine: Quarterly report, October 1-December 31, 1987. Garrett, H.E.; Reid, R.K.; Sword, M.A. (Missouri Univ., Columbia (USA). School of Forestry, Fisheries and Wildlife). 1987. Contract FG01-86CE15270. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004014/JAW.

The studies explore two related hypotheses. The potential of boron and indole acetic acid to act synergistically to promote the flow of sucrose from the foliage to the roots is being assessed. Further the ability of boron fertilization to disrupt the production of phenols by the host is determined. Since phenols inhibit mycorrhizal colonization, it is reasoned that inhibition of phenol production should facilitate plant growth. (DT)

14406 (DOE/CH/10199—T1) Oxygen evolution from water by the water-dehydrogenase enzyme: Annual report, June 15, 1985-June 14, 1986. Dismukes, G.C. (Princeton Univ., NJ (USA)). Feb 1986. Contract FG02-84CH10199. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003407/JAW.

The primary objective of this research is to isolate and characterize the functional enzyme responsible for O_2 evolution from spinach membranes. Previous work from our laboratory has shown that release of a 33kDa, peripheral-membrane protein from thylakoid membranes by osmotic shock is correlated with the release of 2 mn ions that are essential for the oxidation of water. We have extended this work within the past year to show that selective treatments can be used to titrate the release of proteins and manganese while abolishing O_2 evolution. The lost activity correlates precisely with the content of the 33kDa protein which remains bound to the membrane. Furthermore, with increasing pH, four manganese ions are released, with the initial 2-3 ions being released cooperatively. This evidence supports our earlier spectroscopic results showing that the 4 manganese ions are coordinated in a common site which is organized into a binuclear pair and another pair of unknown grouping. The 33kDa protein forms part of the protein complex needed to bind the four manganese ions in a functional state in close association with the photochemical reaction center complex. The binding site on the reaction center is still undetermined, but most probably involves an integral membrane protein of 34kDa. The four manganese ions are arranged in the common site so that 2 bind preferrentially to the peripheral 33kDa protein. How the other pair binds is not yet clear but may involve the integral 34kDa protein. The removal of two other peripheral proteins of masses 23kDa and 17kDa was found to inactivate O_2 evolution, but this could be reversed by addition of excess Cl and Ca(II). These proteins are not involved in the binding of manganese and play more of a regulatory role in the catalytic process. 7 refs.

14407 (DOE/ER/13367—3) [Corn storage protein: A molecular genetic model]: Performance report. Messing, J. (Rutgers--the State Univ., Piscataway, NJ (USA). Waksman Inst. of Microbiology). 1987. Contract FG05-85ER13367. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004931/JAW.

A 10 kD zein was isolated from a high methionine inbred line of corn (BSSS-53) which was found to largely account for the elevated methionine levels in this cultivar. The gene for this zein was isolated and sequenced. In addition the gene for maize glutamine synthetase was cloned using rescue complementation in E Coli. (DT)

14408 (DOE/ER/13713—1) [The genetic and molecular biology of hydrogen metabolism in sulfate reducing bacteria]: Progress report. Wall, J.D. (Missouri Univ., Columbia (USA)). Dec 1987. Contract FG02-87ER13713. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004350/JAW.

Studies aimed at developing methods to exploit the genetics and molecular biology of the sulfate-reducing bacteria are described. The long-term goal of these studies is to examine the H_2 metabolism of Desulfovibrio desulfuricans. We recently observed transduction mediated by an apparently defective bacteriophage. The requirements for transduction, the efficiency of cultures as donors or recipients and the kinetics of production of the phage have been examined. Since it is sometimes necessary to manipulate the bacterial cultures outside the anaerobic chamber, it seemed pertinent to establish the oxygen tolerance of the D. desulfuricans cultures. We observed dramatic morphological responses of colonies upon exposure to air. The development of a genetic exchange process was predicated on the facility of handling these bacteria during standard microbiological procedures. Experience with these bacteria has revealed that for D. desulfuricans ATCC 27774, the dou-

bling time in the standard lactate/sulfate based medium at 31 C is 6 to 9 hours and that 7 to 9 days is required to observe good colony formation.

14409 (IFNP—PI/X/71F) Tables of biomass and volume of stands of white spruce at variable density up to 60 years after their planting at the Petawawa Forestry Institute. Berry, A.B. (Institut Forestier National de Petawawa, Chalk River, Ontario (Canada)). 1987. 27p. (In French). (MICROLOG—87-05655). Petawawa National Forestry Institute, Technical Information and Distribution Centre, Chalk River, Ont., Canada K0J 1J0; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Recent remeasurements of sample plots in white spruce plantations at the Petawawa National Forestry Institute were used to update and revise previously published yield tables. Those presented here cover 20 to 60 years from planting by age classes, six planted spacings, and five site index classes. The data shown for each site index-age-spacing combination are dominant hight, average hight, number of trees, mean diameter, total basal area, total volume, merchantable volume, mass of total tree above ground, mass of main stem including bark, and mass of merchantable stem including bark.

14410 (INIS-BR—748, pp 187) Photoelectrochemical cells of CdSe/sub x/Te/sub 1-x/ polycrystal. Motisuke, P.; Brasil, M.J.S.P.; Moro, J.R.; Decker, F. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14411 (INIS-BR—748, pp 187) Characterization of CdSe polycrystalline films. Brasil, M.J.S.P.; Motisuke, P.; Moro, J.R. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14412 (INIS-BR—910, pp 91) Interaction study of cellobiose with β-glucosidase by C-13 NMR measurements. Lepri, A.; Marchettini, N.; Pogliani, L.; Tiezzi, E.; Ulgiati, S. (Siena Univ., Italy. Dipt. di Chimica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

14413 (NBNRE/ME—83/10) An investigation of the peat resources of New Brunswick. Keys, D.; Henderson, R.E. (New Brunswick Dept. of Natural Resources and Energy, Fredericton (Canada). Minerals and Energy Div.). 1987. 239p. (MICROLOG—87-05638). New Brunswick Mineral Resources Division, Centennial Bldg., P.O. Box 6000, Fredericton, N.B., Canada E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

More than 20,000 field sites were investigated on 817 peatlands to acquire data on the peat and peat core was examined to determine the depth, botanical composition, von Post degree of humification and other characteristics. Sample cores for various physical and chemical analyses were collected at 243 sites on 215 peatlands. A costom computerized data management system has been created to allow retrieval at the site, deposit, and regional levels. The compiled data are portrayed on 289 sets of maps and cross sections with written descriptions of each peatland. More than 20 peatlands are currently leased from the province for the production of horticultural peat. Other existing utilizations include agricultural development, enhanced waterfowl habitat, and recreation/conservation uses. The inventory data provides sufficient information to assess the utilization potential of each peatland. The compiled information is an initial step in the formulation of a long-term resource management strategy to ensure this nonrenewable resource is utilized in a manner that contributes the maximum benefit to the province.

14414 (NMRDI—2-75-5616) Concentrating photovoltaic collectors fabrication design: Final report. MacPherson, M.R. (Wattsun Corp., Albuquerque, NM (USA)). Oct 1987. 50p. NTIS, PC A03/MF A01 - NMRDI, 457 Washington, SE, Albuquerque, NM 87108. Order Number DE88900236/JAW.

The Wattsun Corporation has developed a concept and prototype for a concentrating photovoltaic collector that has the potential for significant cost reductions over existing commercially-available systems. The concept uses small lens elements concentrating solar energy on small photovoltaic cells. Modules are less than one inch thick, containing lenses one-half inch square focusing on cells one-eighth inch square. The present report discusses experimentation designed to finalize materials selection and fabrication procedures.

14415 (NP—8751690) Investigations on the energy balance of conventional heated digester gas storage tanks. Consequences for the dimensioning of digester gas storage tanks and the digester heating system. Steinle, E. (Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Inst. fuer Wasserwesen). 1987. 311p. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751690/JAW.

The aim of this investigation was to describe the energy and mass balance of conventional heated digester gas storage tanks and to verify the required theoretical equations by measurements and data collection on large scale digester gas storage tanks. Variable input parameters should also be taken into account here. It was also intended to represent the effect of variations in the amount of gas generated and of gas storage on the availability of the gas for energy generation. The results must be regarded as the basis for improvements in the process and technique of sludge digestion from the point of view of energy balance.

14416 (PB—88-131933/XAB) Bulletin of the Electrotechnical Laboratory, Vol. 51, Nos. 5 and 6, 1987. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 116p. (In Japanese). NTIS, PC E05.

See also PB—88-131941 through PB—88-131974 and PB—88-131842.

Contents include: Characterization of hydrogenated amorphous silicon by surface photovoltage and capacitance-voltage measurements using liquid Schottky barriers; Amorphous silicon solar cells using a metal substrate; Experimental fabrication of thin-film single crystalline solar cells; Laser crystallized silicon films on alumina ceramic substrates and application to think film c-Si solar cells; Solar-cell characteristics of high efficiency polycrystalline silicon solar cells using solar grade (SOG) cast wafers; Molecular beam epitaxy or GaP films on Si substrates; Minority-carrier lifetime in solar-grade crystalline semiconductor materials; Photon collection enhancement by white rear cover reflection and the design of reference cell for module performance measurement; Global radiation model and angular distribution of the diffuse irradiance; Effect of atmospheric parameters on solar-cell performance under global irradiance.

14417 (PB—88-131941/XAB) Amorphous silicon solar cells using a metal substrate. Yamanaka, M.; Hayashi, Y.; Karasawa, H. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 8p. (In Japanese). NTIS, PC E05.

Included in Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 5-6, 30-37(1987).

The electrical-contact characteristics of alpha-Si:H films on the metal substrates were studied. Good ohmic contacts between alpha-Si:H films and the metal substrates was obtained by the hydrogen plasma treatment of the metal substrates prior to alpha-Si:H film deposition. Then, fabrication conditions to avoid micro-void formation in the surface of alpha-Si:H p-i-n solar cells on the metal substrates were investigated. The micro-void formation were avoidable by the selection of p-layer growth conditions (substrate temperature, concentration of B_2H_6, and thickness of p-layer). Finally,

an alpha-Si:H solar cell was experimentally fabricated to put the above developed technology to practical use. A conversion efficiency of 7.8% was obtained by optimizing growth conditions of alpha-Si:H solar cells. It was the highest value among alpha-Si:H solar cells without an alpha-SiC p-layer or a micro-crystalline p-layer.

14418 **(PB—88-131958/XAB) Experimental fabrication of thin-film single crystal solar cells.** Hayashi, Y.; Nagai, K.; Ishii, K.; Yoshihara, H. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 3p. (In Japanese). NTIS, PC E05.

Included in Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 5-6, 38-40(1987).

Experimental thin-film single-crystal solar cells with various cell thickness were fabricated. The thin films were made by etching single-crystal silicon wafers in KOH etchant. The cell structure was n(+) p junction type with front and back surface passivation by thermal SiO_2 and back surface field by a high-concentration boron-doped layer at the back surface. Conversion efficiency of the cell depended on the thickness and showed maximum value of 17% (AM 1.5, 100mW/(cm sq) at the thickness around diffusion length of minority carriers (about 36 micrometers in this case). This dependency coincides well with a theoretical calculation. The thin-film crystalline solar cell was proved to be one of best approaches to realize low cost and high efficiency.

14419 **(PB—88-131966/XAB) Laser-crystallized silicon films on alumina ceramic substrates and application to thin-film c-Si solar cells.** Ishii, K.; Takahashi, T.; Hayashi, Y.; Nakamura, Y.; Kondo, Y. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 8p. (In Japanese). NTIS, PC E05.

Included in Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 5-6, 41-48(1987).

Crystallization technology of 3- or 5-micrometer-thick silicon films on low-cost alumina ceramic substrates by c-w Ar laser irradiation is described. Crystalline silicon films with maximum grain size of 100 x 10 micrometers were obtained by introducing buffer layers consisting of a spin coated SiO_2 layer and a CVD Si_3N_4 layer. The effectiveness of the buffer layers for enlargement of grain size and suppression of diffusion of contaminating impurities in the substrate into the silicon film while crystallizing was confirmed. As for valency-controlling impurity doping, boron doping from spin-coat boron-doped SiO_2 as a part of the buffer layers was examined. Thin-film c-Si solar cells using such laser-crystallized thin films were fabricated. The structure is ITO/n(+) alpha-Si:H/ thin film p-type c-Si/buffer layers/alumina ceramic substrate. The photocurrent of the cells was 70% of that of a control bulk cell having the same surface junction structure.

14420 **(PB—88-131974/XAB) Molecular-beam epitaxy of GaP films on Si substrates.** Kawanami, H.; Ishihara, S.; Nagai, K.; Ishii, K.; Hayashi, Y. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 13p. (In Japanese). NTIS, PC E05.

Included in Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 5-6, 57-69(1987).

Molecular-beam epitaxy (MBE) of GaP films on Si substrates was developed because this structure has possibilities to realize GaP/Si-based high efficiency (about 36%) tandem solar cells and also GaP/Si-based opto-electronic IC's. A low-temperature Si surface cleaning method at a temperature as low as 800 C was established. Single-crystal GaP films were successfully grown on Si (001) substrates in a wide growth temperature range from 300 c to 600 c. During the film growth, Sn and Si were doped for n-type dopants and Be was doped for the p-type one. Also, Zn-O complexes that act as radiative recombination centers were successfully doped during the growth of GaP films. Process compatibility of Si-device and GaP-device processes was shown by a fabrication of opto-electronic IC which integrates GaP LED's and Si MOSFET's.

14421 **(SERI/CP—211-3171) Proceedings of the polycrystalline thin film program meeting.** (Solar Energy Research Inst., Golden, CO (USA)). 1987. Contract AC02-83CH10093. 203p. (CONF-8707100—). NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE87001169/JAW.

From Polycrystalline thin film program meeting; Lakewood, CO, USA (20 Jul 1987).

Cadmium telluride, copper selenide indium selenide, and cascade solar cells are all discussed in these proceedings on thin films. (BCS)

14422 **(SERI/SP—232-3079a) Microalgae Culture Collection, 1986-1987: Addendum.** Johansen, J.; Lemke, P.; Nagle, N.; Chelf, P.; Roessler, P.; Galloway, R.; Toon, S. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1987. Contract AC02-83CH10093. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005117/JAW.

In 1984, the SERI Microalgae Culture Collection was established in support of the US Department of Energy's Biofuels and Municipal Waste Technology Program. It provides a repository for strains identified or developed for mass culture biomass production and makes these strains readily available to the research community. The strains in the collection have been selected for their potential in biomass fuel applications, and many produce significant quantities of cellular storage lipids. Two catalogs of the Microalgae Culture Collection have been printed and distributed free to those requesting them, one for 1985-1986 (Anonymous 1986) and one for 1986-1987 (Barclay et al., 1986). The 1986-1987 catalog is still current, and this year we plan to print only this addendum to that catalog. We will list only those species newly characterized and not listed in the 1986-1987 catalog. This includes a number of species collected as part of the cold-water collection and screening program as well as species collected from warm waters. Modifications to culture recipes are given. We are also providing a list of all past names of culture strains along with their current SERI designation. 4 refs.

14423 **Defect levels in CdS/$CuInSe_2$ thin-film solar cells.** Ramanathan, V.; Noufi, R.; Powell, R.C. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, Colorado 80401). *Journal of Applied Physics;* 63: No. 4, 1203-1206(15 Feb 1988). Contract AC02-83CH10093.

Thermally stimulated capacitance spectroscopy has been employed to study the defect levels in high-efficiency, CdS/$CuInSe_2$ thin-film solar cells. Voltage bias changes were used to probe the majority-carrier traps and light bias was employed, for the first time, to reveal minority-carrier traps. The light bias thermally stimulated capacitance has shown the presence of a distribution of electron trapping levels in $CuInSe_2$. The capacitance under steady illumination shows that the traps produce a large photocapacitance. The implications of these observations in terms of device performance is discussed.

14424 **Energy crops.** *Journal of Forestry;* 85: No. 9, 18-20, 22, 24, 26(Sep 1987). Contract AC05-84OR21400.

Research on wood-energy crops is leading the forestry profession into a new era of more intensive silviculture. The driving force for this research is the anticipated need for large, renewable quantities of wood biomass for conversion to gasoline and gaseous fuels. The wood consumption of a biomass conversion facility will be in the range of 200,000 to 1 million dry megagrams per year (1 megagram = 1 metric ton = 1.1 English tons), similar to the demand of a pulp mill. If a new biomass-based energy industry is to be sustained simultaneously with other forest-products industries, there will be a vital need to produce more wood faster and on more land. Intensive culture of hardwoods appears to fit this need very well and can eventually provide specialized biomass for particular energy conversion technologies. In simple terms, the challenge has been to increase early growth and reduce rotation length to offset the higher expenses of intensive culture. Research has focused on selection and improvement of suitable trees and cultural practices to increase their productivity on marginal-to-good agricultural sites. The economic questions have addressed the landowner's cash flow and profit requirements, which provide the reason for short rotation of 3 to 10 years. This approach is leading forestry practices to more highly productive land and increasing wood supplies, and is offering farmers an alternative crop.

14425 Reconstitution of chlorophyll a/b light-harvesting complexes: xanthophyll-dependent assembly and energy transfer. Plumley, F.G.; Schmidt, G.W. (Univ. of Georgia, Athens). *Proceedings of the National Academy of Sciences of the United States of America;* 84: No. 1, 146-150(Jan 1987). Contract FG09-84ER13188.

A method for in vitro reconstitution of the chlorophyll a/b light-harvesting complex from LiDodSO$_4$/heat-denatured or acetone-extracted photosynthetic membranes has been developed. Characterization of the minimum components necessary for the functional organization or pigments in these membrane complexes reveals that xanthophylls are essential structural components.

14426 Biotechnological advances in processing municipal wastes for fuels and chemicals. Antonopoulos, A.A. (ed.). Park Ridge, NJ; Noyes Publications (1987). 488p. Noyes Publications, Mill Road at Grand Ave., Park Ridge, NJ 07656.

Research and development efforts in the area of municipal-waste bioconversion to fuels and other valuable chemicals has generated a wealth of information. The book covers many research areas, with primary emphasis on understanding the physiology, biochemistry, and genetics of microbes involved in anaerobic digestion; the various microecological interactions, the biological production of fuels and chemicals; and the generation and extraction of landfill gas. The authors appraise the current status of their fields and offer some research perspectives.

14427 High-efficiency intrinsically and extrinsically passivated laser-processed silicon solar cells. Wood, R.F.; Westbrook, R.D.; Jellison, G.E. Jr. (Solid State Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 519-524 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC05-84OR21400.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Silicon solar cells with efficiencies of —19% AM1.5 have been fabricated by pulsed excimer laser processing. A unique characteristic of these cells is that the surfaces are passivated intrinsically to give open circuit voltages as high as 640 mV without high-temperature oxidation. The growth of a thermal oxide to passivate the front surface (extrinsic passivation) leads to efficiencies of the laser-processed cells of > 19.5% AM1.5. The fabrication of both types of cells utilizes a simple, non-mass analyzed, glow-discharge implantation technique. Fine-line (— μm) photolithography was used to suppress carried recombination at the interface between the metallization and the emitter region. Optimized, thermally evaporated ZnS/MgF/sub 2/ AR coatings were employed to give near-optimal current improvement ratios.

14428 Resistivity and thickness effects in dendritic web silicon solar cells. Meier, D.L.; Hwang, J.M.; Greggi, J.; Campbell, R.B. (Westinghouse R and D Center, 1310 Beulah Road, Pittsburgh, PA 15235). pp 506-513 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The decrease of minority carrier lifetime as resistivity decreases in dendritic web silicon solar cells is addressed. This variation in lifetime is shown to be consistent with the presence of distribution of defect levels in the bandgap which arise from extended defects in the web material. The extended defects are oxide precipitates (SiO/sub x/) and the dislocation cores they decorate. It follows that the sensitivity to this background distribution of defect levels increases with doping because the Fermi level moves closer to the majority carrier band edge. For high-resistivity dendritic web silicon which has a low concentration of these extended defects, cell efficiencies are as high as 16.6% (4 cm/sup 2/, 40 ohm-cm boron-doped base, AM1.5 Global, 100mW/cm/sup 2/, 25°C JPL LAPSS1 measurement) and a corresponding electron lifetime of 38 μs have been obtained.

14429 Wide bandgap passivation layers on silicon. Case, C.; Landis, G.; Beaulieu, R.; Loferski, J.; Sekula, P.; Vernon, S.M.; Spitzer, M.B.; Keavney, C.J.; Haven, V. (Brown Univ., Providence, RI 02912). pp 398-404 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The research problem that has been addressed in this work is the deposition of ZnS, ZnS/sub 0.9/Se/sub 0.1/, and GaP, which are candidate lattice-matched wide handgap materials intended to replace SiO/sub 2/ passivation on silicon solar cells. The thin films were deposited by MOCVD, resistance evaporation or sputtering. Epitaxial GaP and ZnS films cause increases of internal quantum efficiency at short wavelengths. Reductions of J/sub o/ comparable to that generated by SiO/sub 2/, and increases in V/sub oc/ were also observed. Film growth morphology was found to be a function of substrate temperature, orientation and the success of in situ removal of the native oxide.

14430 Effects of defect density and compositional grading on GaAsP photovoltaic performance. Wanlass, M.W.; Emery, K.A.; Al-Jassim, M.M.; Mason, A.R. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). pp 530-535 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The photovoltaic performance of n+/p/p+ GaAs/sub 0.74/P/sub 0.26/ shallow homojunctions is studied as a function of the dislocation density in the vicinity of the n+/p junction. Compositionally graded GaAsP/GaAs heterostructures grown by atmospheric pressure metalorganic vapor phase epitaxy (APMOVPE) are used to produce shallow-homojunction devices whose dislocation densities vary over a wide range. The device structures are characterized and compared using a variety of methods. In general, fewer compositional steps and thinner grades resulted in rougher surfaces, higher defect densities, and lower conversion efficiencies. Strong correlations are seen between the grading structure, dislocation configuration, surface morphology and solar cell characteristics.

14431 Voltage-matched configurations for multijunction solar cells. Gee, J.M. (Photovoltaic Cell Research Div., Sandia National Labs., Albuquerque, NM 87185). pp 536-541 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Novel methods for interconnecting the subcells of a multijunction solar cell are investigated. The subcells are connected in parallel in these new methods. The bandgaps of the subcells must be selected for matched voltages when operated in parallel. The authors refer to multijunction solar cells with the subcells connected in parallel as having a voltage-matched configuration. Computer analyses of multijunction solar cells with a voltage-matched configuration and with series-connected subcells were performed. Roughly the same performance was found. Several advantages for the voltage-matched configuration relative to multijunction solar cells with series-connected subcells were identified and are discussed.

14432 High-rate deposition of hydrogenated amorphous silicon films and devices. Luft, W. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO 80401). pp 564-568 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The effects of power density, substrate temperature during deposition, feed gas concentration, and substrate bias on deposition rate, photo- and dark conductivities, optical gap, feed gas utiliza-

tion, hydrogen content, spin density, and dihydride-to-monohydride ratio are analyzed primarily for RF glow-discharge deposition of a-Si:H films. Results for films produced from monosilane are compared with those for films from disilane. The effect of deposition rate on a-Si:H solar-cell efficiency is discussed.

14433 **Maintaining window transparency in photo-CVD: A simultaneous etch/deposition method.** Langford, A.A.; Stafford, B.L.; Tsuo, Y.S. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). pp 573-576 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

A novel solution to the loss of window transparency due to film deposition in photochemical vapor deposition of a-Si:H(F) is described. A reactive purge gas, such as XeF/sub 2/, flowing near the ultraviolet transparent window continuously etches any window deposition. The gas flow rates are adjusted so that no etching occurs near the substrate where film deposition is desired. After many depositions, the window has retained its transparency at 185 nm without requiring cleaning. The deposition system is UHV compatible with a load-lock to minimize atmospheric impurities.

14434 **Amorphous silicon p-i-n layers prepared by a continuous deposition process on polyimide web.** Jacobson, R.L.; Jeffrey, F.R.; Westerberg, R.K.; Williams, R.C. (3M Co., 3M Center, Bldg. 201, St. Paul, MN 55144). pp 588-592 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

A novel multi-chamber deposition system is described. The system deposits amorphous silicon p-i-n layers on metallized polyimide web in a continuous roll-to-roll deposition process. The p,i, and n layers are deposited in three separate chambers located within one large vacuum vessel. The metallized web enters and exits each chamber in sequence while silicon layers are deposited by plasma enhanced CVD using a RF diode configuration. The deposition characteristics of the above system were studied in detail. Uniform layers are deposited over the 10 cm width of the polyimide web and adhesion is excellent. High quality p-i-n and n-i-p layers have been produced in a continuous deposition mode over deposition times of many hours. Maximum conversion efficiency of solar cells prepared by topcoating with a transparent conducting oxide is 6% on specular substrates, 7% on textured substrates.

14435 **Successes and plans of the SERI/DOE amorphous silicon research project.** Wallace, W.; Sabisky, E.; Stafford, B.; Luft, W. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO 80401). pp 593-598 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

In 1984, the Amorphous Silicon Research Project (ASRP) at SERI established a three-year Government/Industry Partnership program directed toward the key objectives of achieving efficiencies of 12% and 8%, respectively, for amorphous silicon single-junction cells (1 cm/sup 2/) and submodules (1000 cm/sup 2/). The key objectives have been met. In 1987, a new three-year Government/Industry Partnership program was initiated to achieve even more aggressive goals by 1990. The key objectives of the new program are to achieve efficiencies of 10% and 13%, respectively, for amorphous silicon single-junction and multijunction submodules (>900 cm/sup 2/) and an efficiency of 18% for multiple-bandgap, multi-junction cells (1 cm/sup 2/). Advances made in fundamental research activities are discussed which have contributed to improvements in the performance levels of amorphous silicon cells and submodules.

14436 **In situ process diagnostics of silane plasma for device-quality a-Si:H deposition.** Shing, Y.H.; Perry, J.W.; Hermann, A.M. (Jet Propulsion Lab., California Institute of Technology, Pasadena, CA 91109). pp 577-581 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Coherent anti-Stokes Raman spectroscopy (CARS) and mass spectrometry (MS) were applied to in situ process diagnostics of silane plasma for device-quality a-Si:H film deposition. Silane depletion was directly measured by CARS, and is linearly dependent on RF power in the region of 4 to 12 W with a slope of 0.5%/mW-cm/sup -2/. The depletion is also dependent on SiH/sub 4/ flow rate starting with a 50% depletion at a low flow rate of 5.6 sccm and asymptotically approaching an 8% depletion at a high flow rate of 80 sccm. The mass spectral line signal intensity of disilane increases with RF power and shows an apparent transition at —6 W. Disilane formation in silane plasma, film deposition rate, and silane depletion ratio as a function of the RF power indicate that the film growth mechanism in the low power region of 3.5-6.5 W is substantially different from that in the high power region of 6.5-12 W.

14437 **Comparison of the temperature coefficients of the basic I-V parameters for various types of solar cells.** Osterwald, C.R.; Glatfelter, T.; Burdick, J. (Solar Energy Research Institute, Golden, CO 80401). pp 188-193 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

It is well-known that the maximum power output of photovoltaic devices changes with temperature. Therefore, the temperature coefficients of the basic device performance parameters (open-circuit voltage, short-circuit current, fill factor, and efficiency) are important factors which must be taken into account in the design of a photovoltaic power system, where temperature changes occur throughout the day and year. This paper reports results of experimental temperature coefficient measurements obtained on a wide variety of different photovoltaic devices, many of which have not had temperature coefficient data published previously.

14438 **Uncertainty analysis of photovoltaic efficiency measurements.** Emery, K.A.; Osterwald, C.R.; Wells, C.V. (SERI, 1617 Cole Blvd., Golden, CO 80401). pp 153-159 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

While the conversion efficiency is the most important single indicator of the performance of a photovoltaic device, a complete uncertainty analysis which includes all sources of systematic and random errors associated with the efficiency measurement process has not been published to date. In this paper, the authors report the results of an analysis which has shown that a total uncertainty of +-1.0% of the efficiency is possible if all sources of systematic and random errors are minimized. A more typical value of +-7% should be expected even when neglecting errors due to linearity, hysterisis, and measurement procedures. The systematic error limit for the typical case was found to five times as large as the random error, which demonstrates that the common method of claiming the reproducibility or repeatability in the efficiency to be the total error can be very misleading and can grossly underestimate the actual error.

14439 **InP based solar cells for space application: Reduction of external losses.** Wu, X.; Coutts, T.J.; Dhere, R.G.; Gessert, T.A.; Dhere, N.G. (SERI, 1617 Cole Blvd., Golden, CO 80401). pp 140-145 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Although InP based solar cells have considerable potential for space applications, it is necessary to improve efficiencies, to around the level of GaAs or Si cells, before their excellent radiation resistance can be regarded as a dominant advantage. In this paper, which concentrates on ITO/InP cells, the authors shall present data relating to reduction of the contact resistance of the rear surface metallization, reduction of reflectance losses by choosing ITO deposition conditions to give specific optical properties, and reduction of losses associated with the grid. Simultaneous optimization of all of these has led to improve values of J/sub sc/. For devices of approximately 1 cm/sup 2/ in area the largest J/sub sc/ achieved to data is 28.1 mAcm/sup -2/. For this particular cell the equivalent AMO value of J/sub sc/ was 34.6 mAcm/sup -2/, the largest reported for any InP based cell.

14440 **Advanced metallization for highly efficient solar cells.** Tobin, S.P.; Spitzer, M.B.; Bajgar, C.; Geoffroy, L.; Keavney, C.J. (Spire Corp., Bedford, MA 01730). pp 70-75 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The authors report techniques for obtaining improved metallization for both GaAs and Si solar cells. Both conversion efficiency and temperature stability are addressed. Higher efficiency is attained by forming high aspect ratio lift-off patterned metallization with a rectangular cross section. They show how such metallization can yield reduced grid line series resistance without increased shadow loss. GaAs metallization employing a titanium nitride diffusion barrier is also described. Temperature cycling investigations show that this system is stable to temperatures exceeding 500°C. Finally, the temperature stability of metallization formed on a highly efficient silicon cell is discussed.

14441 **Effects of n/sup +/ doping profile on V/sub oc/ and yield of GaAs shallow homojunction solar cells.** Gessert, T.A.; Blakeslee, A.E.; Emery, K.A. (Solar Energy Research Institute, Golden, CO 80401). pp 58-62 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

GaAs shallow homojunction solar cells were grown for the specific purpose of studying the effect on the open circuit voltage of changing the profile of the n/sup +/ emitter layer. It was found that grading the emitter layer from 2.5x10/sup 18/ cm/sup -3/ at the junction to 5x10/sup 18/ cm/sup -3/ at the surface lead to an improvement in the open-circuit voltage resulting in a maximum value of 993 mV, one of the highest values ever reported for this type of structure. In addition, a correlation exists between grading the n/sup +/-layer and the yield per substrate.

14442 **Progress in crystalline materials for high efficiency solar cells.** Benner, J.P.; Leboeuf, C.M. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO 80401). pp 53-57 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

This paper reviews the progress in DOE/SERI sponsored research to improve the properties of single crystal semiconductors grown in conventional as well as novel regimes. Given the relatively advanced level of understanding of silicon an III-V semiconductors, the project focuses on these materials for their potential to provide photovoltaic devices with very high efficiencies for both flat plate and concentrator applications.

14443 **Crystalline cell research: Today and tomorrow.** King, D.L.; Arvizu, D.E. (Sandia National Labs., Albuquerque, NM 87185). pp 43-48 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Recent consolidation of the U.S. Department of Energy Photovoltaic Program has enabled Sandia to assume a primary role in the continuing research and development of crystalline cell technology. Silicon material growth and characterization, one-sun and concentrator silicon cells, and single and multijunction III-V concentrator cells are all being considered. This expanded responsibility gives us the opportunity to review previous programs and to coordinate a specifically directed research that capitalizes on recent advances in all of the areas mentioned. This paper summarizes the status of current crystalline cell technology, identifies Sandia's proposed research direction, and provides well-supported efficiency projections for Si concentrator cells and for one-sun Si cells.

14444 **GaInP/sub 2//GaAs monolithic tandem solar cells.** Olson, J.M.; Kibbler, A.; Kurtz, S. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). pp 285-288 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The two-terminal, cascade combination of a Ga/sub 0.5/In/sub 0.5/P (GaInP/sub 2/) homojunction and a GaAs homojunction has a one-sun, AM1.5 theoretical efficiency of 34%. Since GaInP/sub 2/ is lattice matched to GaAs, the GaInP/sub 2//GaAs tandem cell is more likely to achieve an efficiency greater than 30% than a lattice mismatched combination. Using MOCVD, the authors fabricated single junction devices in GaInP/sub 2/ with fill factors and V/sub oc/'s as high as 0.88 and 1.32 V, respectively. At present, however, the efficiency of the GaInP/sub 2//GaAs tandem cell is limited by a relatively low short circuit current in the GaInP/sub 2/ top cell, and the development of a high conductance junction interconnect. These and other recent results are presented.

14445 **The photovoltaic future: Current research directions.** Basso, T.S.; Mc Connell, R.D.; Surek, T. New York, NY; American Institute of Chemical Engineers (1986). 19p. (CONF-860826—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Technical Paper 10E.

Improvements in materials and processing, solar cell design, and cell fabrication techniques for the new generation of PV technologies continue to result in efficiency gains, a bottom-line parameter for the conversion of sunlight into electricity. Steady and dramatic advances are expected to continue during this decade. As the physics, chemistry and device engineering of thin film single junction and multijunction solar cells become better understood and controlled, industry's ability to fabricate low-cost, high performance and long-term reliable photovoltaic electricity devices will emerge. The continued federal/industry partnership should accelerate attainment of long-term goals. The end result will be the opportunity for the nation to utilize photovoltaics as a secure, inexhaustible energy supply.

14446 **The effects of dopant profiles on the device parameters of p-i-n and n-i-p a-Si solar cells.** Jeffrey, F.R.; Vernstrom, G.D.; Weber, M.; Epstein, K.A. (E and I Sector Lab., 3M Center, St. Paul, MN 55144). pp 531-536 of Materials issues in amorphous semiconductor technology. Adler, D.; Hamakawa, Y.; Madan, A. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

The authors studied the effects of intrinsic layer dopant profiles on the open circuit voltage and fill factor of p-i-n and n-i-p solar cells. Data is presented showing that boron profiling into the i-layer is responsible for the commonly observed difference in open circuit voltage between p-i-n and n-i-p devices. As only a shallow profile is required to produce this effect, it is proposed that the lower V/sub oc/ samples are being limited by surface recombination at the p/i interface and that the boron profile reduces this recombination current. Spectral response data clearly shows a shifting of high collection from the back to the front of the cell.

1406 Photovoltaic Power Systems

14447 (BMFT-FB-T—86-220) Direct conversion of solar energy to thermal energy. Final report. Sizmann, R. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Muenchen Univ. (Germany, F.R.). Sektion Physik). Dec 1986. 133p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751661/JAW.

This final report summarizes the results during the period 1982 to 1985. 1) Selective coatings (cermets) were produced by simultaneous evaporation of copper and silicon dioxide. Coatings have been analyzed by computer assisted spectral photometers and ellipsometers. The hemispherical emittance has been determined by calorimetric measurements. In addition, methods of solid state physics have been applied (AUGER, ion sputtering). 2) Steady state test procedures for covered and uncovered collectors were investigated. A method for evaluating the transient behaviour of collectors has been developed. The derived transfer functions describe their transient behaviour. 3) The evaluation of the operation of solar systems requires a sophisticated data acquisition of meteorological data. A stochastic approach is used for reducing the meteorological data volume. Data sets can be synthezised which are statistically equivalent to the original data. 4) A simulation program for solar systems using analytical solutions of differential equations has been developed. A large solar DHW system has been optimized by a detailed modular simulation program. 5) A microprocessor assisted data acquisition records the IV-characteristics of solar cells and solar cell systems in less than 10 ms. Measurements of a large photovoltaic installation (50 m/sup 2/) are reported and analyzed. With 68 refs., 23 tabs., 99 figs..

14448 (N—88-12875) Design description report for a photovoltaic power system for a remote satellite earth terminal. Marshall, N.A.; Naff, G.J. (Hughes Aircraft Co., Long Beach, CA (USA)). Jan 1987. 136p. (NASA-CR—179586; NAS—1.26:179586). NTIS, PC A07/MF A01.

A photovoltaic (PV) power system has been installed as an adjunct to an agricultural school at Wawatobi on the large northern island of the Republic of Indonesia. Its purpose is to provide power for a satellite earth station and a classroom. The renewable energy developed supports the video and audio teleconferencing systems as well as the facility at large. The ground station may later be used to provide telephone service. The installation was made in support of the Agency for International Development's Rural Satellite Program, whose purpose is to demonstrate the use of satellite communications for rural development assistance applications. The objective of this particular PV power system is to demonstrate the suitability of a hybrid PV engine-generator configuration for remote satellite earth stations.

14449 Terrestrial photovoltaic power technology. Jones, G.J.; Post, H.N.; Thomas, M.G. (Sandia National Labs., Albuquerque, NM 87185). pp 25-33 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Advances have occurred in all areas of terrestrial photovoltaic power system technology, from the design procedures to the individual subsystems. The understanding of system requirements and the operating environment has allowed the development of simplified design methods. Major programs on module reliability have resulted in collectors with extremely low failure rates and significantly reduced concerns about collector rates and significantly reduced concerns about collector degradation. Detailed field performance data allow the refinement of suggested guidelines for future system designs and provide updates on current and projected costs. New findings for remote systems allow a better understanding of the areas of photovoltaic cost competitiveness. This paper reviews the current status of photovoltaic system and subsystem design and performance for ech of the major power application sectors -- remote dispersed grid-connected, and large generation centers.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 14787

14450 (SAND—87-0696) Thermal fatigue of stainless steel. Jones, W.B.; Bourcier, R.J.; Van Den Avyle, J.A. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004146/JAW.

Two austenitic steels, 316 Stainless Steel and Alloy 800, have been examined under conditions of both isothermal low cycle fatigue (LCF) and thermomechanical fatigue (TMF). The TMF tests were conducted between 649 and 360°C with a carefully controlled triangular waveform. The LCF tests were performed at 649°C and both kinds of tests were subjected to a strain range of 0.5%. TMF shortened life to 40% for 316 Stainless Steel and to 5% for Alloy 800. The microstructural evolution occurring in both alloys has been examined and we conclude these do not play a role in the life shortening caused by TMF. The TMF does produce asymmetric hysteresis loops with large tensile peak stresses in tests where the maximum temperature corresponded with the peak compressive stress. The influence of TMF on fatigue crack growth rates has been measured and it was found that TMF accelerated crack growth in Alloy 800 and slowed it down slightly in 316 Stainless Steel. The dominant influence of TMF appears to be in fatigue crack initiation, with the tensile peak stress development driving early crack initiation. 31 refs., 11 figs., 4 tabs.

14451 (SAND—87-2622C) HELIOS modelling of point-focusing solar concentrators. Strachan, J.W.; Mulholland, G.P. (Sandia National Labs., Albuquerque, NM (USA); New Mexico State Univ., Las Cruces (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-8704259—1). NTIS, PC A02. Order Number DE88004933/JAW.

From ASME Solar Energy Division conference; Denver, CO, USA (10 Apr 1987).

The modifications to the optical code HELIOS which are required in order to model point-focusing concentrators is presented. HELIOS simulates the optical behavior of reflecting heliostats and was written to model central receiver facilities, specifically that of the Solar Thermal Test Facility at Sandia National Laboratories in Albuquerque, New Mexico. This paper discusses the necessary changes to the HELIOS code and to its input files such that it can successfully model point-focusing concentrators while retaining its computational power. A point-focusing concentrator located at the Solar Thermal Test Facility is presented as a sample case.

14452 Solar small power production facilities. House of Representatives, One Hundredth Congress, First Session, October 20, 1987. Washington, DC; Government Printing Office (1987). 6p.

H.R. 2818 exempts qualifying small power production facilities of not more than 80 megawatts that use solar energy from: (a) the Federal Power Act (FPA); (b) the Public Utility Holding Company Act (PUHCA); and (c) most state laws and regulations governing electric utilities. Current law and regulations exempt qualifying small power production facilities of not more than 30 megawatts that use solar energy from application of the above laws; H.R. 2818, accordingly, raises that ceiling from 30 to 80 megawatts. The Committee on Energy and Commerce considered H.R. 2818, reported favorably on it, and recommended the bill as amended be passed.

14453 Solar one operating results. Lopez, C.W. *Transactions of the American Nuclear Society;* **52**: 2-3(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The 10-MW Solar Thermal Central Receiver Pilot Plant, located near Barstow, California, produced its first electrical power on April 12, 1982. Operation of the facility has demonstrated the technical feasibility of central receiver solar power plants. Commercialization of similar energy conversion facilities is now a matter of economics. The pilot plant, commonly known as Solar One, completed its 2-yr test and evaluation phase on July 31, 1984, and proceeded into its 3-yr power production phase. During the test and evaluation phase, the receiver, collector field, thermal storage, electric power generation, and control and plant support system were integrated and the plant control system was refined to allow automated plant startup, operation in either of eight operating modes, mode transitions, and shutdown. In the power production phase, Solar One is being operated to maximize electrical energy output to allow evaluation of the plant as a viable electrical energy production resource. During this period, operating procedures and equipment modifications are being developed to optimize plant performance. Performance data are also being evaluated to define plant design parameters for future solar power generation facilities.

1408 Ocean Energy Systems

14454 (PB—88-112883/XAB) Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 1, January 1987. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 76p. (In Japanese). NTIS, PC E04/MF A01.

See also PB—85-110237; Portions of this document are not fully legible.

Contents include: preliminary study on membrane and permeator for salinity power generation; architecture of three-dimensional devices (in french); electric quadrupole perturbation coefficients for I=2 spinlevel in angular correlations; structure of energy problems and concept of energy conservation; use of BeO TLDs for high-dose dosimetry in radiation-hardness testing.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 14447, 14775, 14787, 14795, 14819, 14820, 14822, 14828, 14869

14455 (BFR-T—9-1986) Seasonal storage of solar heat of Kungaelv. Claesson, T.; Hultmark, G.; Jilar, T. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 16p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751138/JAW.

The technology and economic aspects of a planned large solar heating plant are reviewed. A simple and cheap system may supply 75 percent of the heating demand in the Kungaelv community. Major parts of the system are: 116 000 m/sup2/ of solar collectors, 400 000 m/sup3/ rock caverns for seasonal heat storage and a district heating network design for low distribution temperatures. The heat cost will be about 0.42 SEK/kWh. (L.E.).

14456 (BMFT-FB-T—86-229) Comparative research and demonstration project for the utilization of solar energy for heating energy conserving greenhouses - continuation. Final report. Thiel, F.; Schradieck, E.P.; Blank, H.; Reichert, J.; Mankin, U. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Landwirtschaftskammer Rheinland, Bonn (Germany, F.R.); Forschungsstelle fuer Energiewirtschaft, Muenchen (Germany, F.R.); Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung). Dec 1986. 92p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751660/JAW.

From 1979 to 1982 four different solar systems were tested in comparison with a reference greenhouse. Concentrating collectors turned out to be unsuitable in this application. The amount of solar energy which can be used is too small. The mechanism of the louvre system turned out to be unsuitable for the strong temperature changes. As far as the unit could be operated, satisfactory results were obtained. The two remaining systems saved about 20% of the energy required after subtracting the auxiliary power. The greenhouse used as a collector seemed to be favourable. The project was continued from 1983 to 1985 with two solar systems and a reference greenhouse. The new foil collector and the greenhouse used as a collector were not profitable from the economic point of view. With improved insulation of the houses good results were obtained. The project was accompanied by systems analysis and simulation models. An analysis of the plants showed that the light reduction inherent within the systems led to a retardation in plant growth. In the greenhouse used as a collector, a good growth rate was observed. With 5 refs., 12 tabs., 50 figs..

14457 (DOE/CE/30808—T1) Interzonal heat transfer: Final report, 15 July 1985-16 December 1986. Winn, C.B.; Burns, P.J.; Kirkpatrick, A.T. (Colorado State Univ., Fort Collins (USA). Dept. of Mechanical Engineering). 1986. Contract AC03-85CE30808. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003133/JAW.

This final report details the work conducted at the Colorado State Univerisity REPEAT Facility for the period from July 15, 1985 to December 31, 1986. The report describes an investigation of interzonal heat transfer mechanisms, and relation of this phenomena to building geometry and temperature distribution. The interzonal theory is developed and compared with experiment in the main body of the report. A FORTRAN program for calculation of the interzonal heat transfer as a function of the zone temperature difference and aperture geometry has been developed. 12 refs., 14 figs.

14458 (DOE/SF/16308—T1) Advanced phase change materials for solar passive heating and cooling of residential buildings: Annual topical report, May 29, 1986-May 29, 1987. Salyer, I.O.; Sircar, A.K. (Dayton Univ., OH (USA)). 1987. Contract FG03-86SF16308. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003216/JAW.

This report describes research conducted in testing hydrocarbons for use as heat storage compounds in solar heated and cooled buildings. Materials tested are crystalline alkyl hydrocarbons and butyl stearate/butyl palmitate. Experimental results are briefly summarized and a discussion of fire retardance is provided. (JDH)

14459 (DTH-LV-MEDD—183) Solar heat - natural gas. An attractive combination. Mikkelsen, S.E. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Jul 1987. 64p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751086/JAW.

When five single-family houses were to switch over to heating by natural gas, the existing and somewhat older furnace with built-in hot water storage was exchanged for a combi hot water unit and a wall mounted gas burner. The hot water unit was equipped with two heat exchanger spirals, one at the top connected to the gas burner and one at the bottom connected to a solar collector with an area of 4.4 m/sup 2/. If the situation is that an older boiler unit will have to be exchanged for a new one and at the same time a solar heating system is installed, a saving of close to DKr. 3,400 per year can be expected on the heating bill. This is, naturally, depending on the condition of the old furnace. The total investment in this situation will be around Dkr. 42,000. The report covers a description of the installations, the values measured and results of the operation. Further, there is a chapter dealing with the construction and dimensioning of such installations, including the importance of size and positioning of the heat exchangers. The report concludes that the type of solar heating system connected to a combi hot water unit, dealt with in the report, technically is a good solution giving no problems provided the recommendations and dimensionings of this report are followed. It is also concluded that economically this is an attractive solution in connection with renewal of the heating system due to the old one being worn-out or when it is a matter of changing over to heating with natural gas. (SM).

14460 **(GRES—1986) GRES 1986 annual report.** (Ecole Polytechnique Federale, Lausanne (Switzerland). Groupe de Recherche en Energie Solaire). 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900360/JAW.

During the last ten years, considerable progress has been made in the use of passive solar energy. Whereas the first research projects in this field were concerned essentially with the problem of collection systems, the emphasis is now on a global building approach which incorporates the building fabric (envelope, structure, etc.), its technical equipment (heating, ventilation, hot water and electrical networks) and how the building is used by its occupants (residential, industrial, commercial, etc.). The research plans of GRES reflect these developments in the scale and content of passive solar energy work. The dynamic thermal behavior of buildings is now considered in conjunction with the passive use of solar energy, both of which are closely related to building physics.

14461 **(NEI-NO—28) Solar air heaters. Final report.** Roestvik, H.N.; Hadland, G. (Roestvik (Harald N.), Stavanger (Norway)). Jul 1985. 46p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751205/JAW.

The report evaluates solar air heaters. Following topics are discussed: 1. Integration and roofing methods for solar collectors in order to achieve aesthetic and economic advantages. 2. New methods for the assembly of standard equipment. 3. Use of air as a calorific medium in solar collectors. 4. Evaluation of 3 different types of heat storages such as salt, water, and rock materials. 5. Use of data technology for the control and recording. 22 drawings, 2 tables.

14462 **(OUP—87-07) Solar energy research at the Department of Physics, University of Oslo. Annual report 1986.** (Oslo Univ. (Norway). Fysisk Inst.). Mar 1987. 56p. (In Norwegian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751117/JAW.

The report surveys and presents the solar energy projects at the Oslo University (Norway) in 1986, which are as follows: 1. Data recording of the solar plant in a university building. 2. Solar energy houses in Drammen. 3. Calculations and measurements of heat losses in solar collectors. 4. Design and test results for the solar heating plants in Moss. 5. Recording instruments and systems for the solar heated houses in Moss. 6. Studies on the use of solar energy in agriculture. 7. Studies on the production methods for solar heating systems in Switzerland and Austria. 22 drawings, 2 tables, 24 references.

14463 **(PB—88-114236/XAB) Effect of storage thermal behavior in seasonal storage solar-heating systems.** Lund, P.D. (Helsinki Univ. of Technology, Otaniemi (Finland). Dept. of Technical Physics). 16 Dec 1986. 44p. (TKK-F-A—604). NTIS, PC E03/MF A01.

An analytical methodology was developed to investigate the effects of storage operational strategies (or, equivalently, stratification) on the performance of a seasonal storage solar-heating system with a constructed water volume. The method is based on a relative comparison between a thermally stratified and well-mixed storage system representing probable extreme outcomes of the subsystem-to-storage loop-control strategies. The effects are described in the form of performance reduction factors that describe maximum changes in the solar collector yield, storage losses, and solar fraction due to storage operational mode. The study indicates that the storage thermal behavior could, in the worst case, affect the yearly solar fraction by a factor of 1.8, but most likely a maximum value from 1.1 to 1.5 could be expected.

14464 **(SERI/TR—252-2897) Experimental studies of heat and mass exchange in parallel-passage rotary desiccant dehumidifiers for solar cooling applications.** Bharathan, D.; Parsons, J.M.; Maclaine-cross, I.L. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1987. Contract AC02-83CH10093. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001119/JAW.

This report presents results of work done to experimentally characterize the performance of rotary desiccant dehumidifiers and to develop and validate analytical methods for evaluating their performance in air-conditioning systems. A facility, the Cyclic Test Facility, and a test-and-analysis procedure were developed to evaluate the performance of the rotary dehumidifiers. Experiments were performed to develop a basic understanding of the simultaneous heat- and mass-transfer processes in the dehumidifiers. Two test articles were tested under cyclic operation to characterize their performance. Detailed accounts of the Cyclic Test Facility, its hardware and instrumentation, the two test articles, and data reduction and analysis methods are provided. The data provide an engineering data base for evaluating rotary desiccant dehumidifiers for cooling applications. 46 refs., 26 figs., 3 tabs.

14465 **(SERI/TR—252-2983) Experimental study of an advanced silica gel dehumidifier.** Bharathan, D.; Parsons, J.M.; Maclaine-cross, I.L. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1987. Contract AC02-83CH10093. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001120/JAW.

This report contains results of work done to experimentally characterize the performance of an advanced, rotary, desiccant dehumidifier and to develop and validate analytical methods for evaluating its performance in air-conditioning systems. A facility, the Cyclic Test Facility, and a test and analysis procedure were developed to evaluate the performance of the dehumidifier. A series of tests was undertaken to understand the simultaneous heat- and mass-transfer processes. An advanced dehumidifier test article was tested under cyclic operation to fully characterize its performance. Brief accounts of this facility, with its hardware and instrumentation, and detailed accounts of the test data and data reduction and analysis methods are presented. The data provide an engineering data base for evaluating rotary dehumidifiers for cooling applications. The dehumidifier's performance, as measured by the effectiveness, agreed with theory to within plus or minus 10%. 16 refs., 16 figs., 1 tab.

14466 **(STF—15A83017) Scandinavian cooperation - solar energy.** Drangsholt, F. (SINTEF, Trondheim (Norway)). Sep 1983. 138p. (In Norwegian). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751185/JAW.

The report discusses the Nordic cooperation regarding practical experience from the utilization of solar energy. Reporting manuals for the inspection procedures of solar heating plants together with cooperated experimental methods are prepared and presented. The waterborne solar collectors are the most usual types of heaters in Sweden and Denmark, but in Norway the heating systems are based on airborne solar collectors. 41 drawings.

14467 **(STF—62A86012) IEA Task XI: "Passive and hybrid solar commercial buildings". National workplan for Norway's participation.** Hestnes, A.G. (SINTEF, Trondheim (Norway)). Oct 1986. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751130/JAW.

This research workplan describes Norwegian activities within the IEA Task XI project: "Passiv and hybrid solar commercial buildings". It is based on the operating agent's overall task workplan and adheres closely to this. Its main purpose is to identify relevant projects and responsible individuals.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 14442, 14447

14468 **(ANL/CNSV-TM—191) Side-by-side comparisons of evacuated compound parabolic concentrator and flat plate solar collector systems at temperatures of 90 to 100°C.** Allen, J.W.; Schertz, W.W.; Wantroba, A.S. (Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004717/JAW.

This collector system study is an extension of a previous system study in which Argonne National Laboratory (ANL) compared the performance of three solar energy systems operated side

by side for over a year. In the present system study, four solar energy systems were operated side by side for part of a year. Two of the collector systems used commercially available compound parabolic concentrator (CPC) collectors, one used a commercially available flat plate collector, and one used an experimental CPC collector built by The University of Chicago. The collectors were mounted in fixed positions; they did not track the sun, and their tilt angles were not seasonally adjusted. All of the collector arrays faced south and were tilted at 42° with respect to the horizon (to match the 42°N latitude at ANL). All four collector systems started each day with their storage temperatures at 90°C. During the day, each system was operated by its own solar controller. At the end of the day, the tanks were mixed and the temperature changes in the tanks were measured. The change in storage energy was calculated from the temperature change, the heat capacity of the storage system, and the pump energy. 6 refs., 5 figs., 5 tabs.

14469 **(DTH-LV—86-5) Test and calculation of solar domestic hot water system performance.** Oestergaard Jensen, S. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Apr 1986. 94p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751145/JAW.

This report contains the results from the measurings and calculations on the two domestic hot water systems installed at the solar experimental house of the Thermal Insulation Laboratory at the Technical University of Denmark. For selected periods, the thermal peformance of the two systems has been measured in detail. For the same periods, the thermal performance has been calculated by means of a computer model - EMGP2. The measured and the calculated thermal performances have then been compared to se how good is the agreement between calculations and measurements. It is further shown that by using the Danish method for testing components in solar heating systems separately and using computer models to simulate the thermal performance of solar heating systems, it is possible to produce a very heavy tool to use when dimensioning solar heating systems.

14470 **(N—88-12870) Light funnel concentrator panel for solar power. Final report.** (Boeing Aerospace Co., Seattle, WA (USA)). May 1987. 60p. (NASA-CR—179223; NAS—1.26:179223; D180—30473-1). NTIS, PC A04/MF A01.

The solar concentrator design concept provides a theoretical concentration efficiency of 96 percent with power-to-weight ratios as high as 50 W/kg. Further, it eliminates the need for fragile reflective coatings and is very tolerant to pointing inaccuracies. The concept differs from conventional reflective mirrors and lens design in that is uses the principle of total internal reflection in order to funnel incident sunlight into a concentrator photovoltaic cell. The feasibility of the light funnel concentrator concept was determined through a balanced approach of analysis, development, and fabrication of prototypes, and testing of components. A three-dimensional optical model of the light funnel concentrator and photovoltaic cell was developed in order to assess the ultimate performance of such systems. In addition, a thermal and structural analysis of a typical unit was made. Techniques of fabricating the light funnel cones, optically coupling them to GaAs concentrator cells, bonding the funnels to GaAs cells, making electrical interconnects, and bonding substrates was explored and a prototype light funnel concentrator unit was fabricated and tested. Testing of the system included measurements of optical concentrating efficiency, optical concentrator to cell coupling efficiency, and electrical efficiency.

14471 **(ESA-TT—1050) Numerical and experimental investigation of the unsteady temperature distribution in solar central receivers.** Lemperle, G. (European Space Agency, 75 - Paris (France)). Jun 1987. Transl. into ENGLISH of Numerische und Experimentelle Untersuchung der Instationaeren Temperaturverteilung in Strahlungsabsorberrohren (Stuttgart, Fed. Republic of Germany, DFVLR), Oct. 1986. (DFVLR-FB—86-43; ETN—87-90872). 130p. NTIS, PC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 37.50.

A finite difference scheme for the calculation of the unsteady temperature distribution in irradiated tubes of a solar central receiver was developed. The computation code is based on the radiation exchange in the visible and IR wavelength range, and on the energy balances for tube wall, heat carrier, and ceramic back wall. The front surface temperature of a sodium-coded receiver was measured by a thermovision device. The measured temperatures show good agreement with the calculated values, and were used to determine heat losses and efficiency.

1420 Heat Storage

REFER ALSO TO CITATION(S) 14463

15 GEOTHERMAL ENERGY

14472 **(CONF-8704110—) Proceedings Geothermal Program Review V.** (Meridian Corp., Alexandria, VA (USA)). 1987. 230p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88003737/JAW.

From 5. geothermal program review; Washington, DC, USA (14 Apr 1987).

Separate abstracts have been prepared for 44 individual presentations. (ACR)

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 14141

14473 **(LA—10619-HDR-Pt.3) Geological structures from televiewer logs of GT-2, Fenton Hill, New Mexico: Part 3, Quality control.** Burns, K.L. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005086/JAW.

A procedure has been developed for extracting geological structures from paper prints of intensity-mode televiewer logs. It was applied to old logs of drill hole GT-2 at the Fenton Hill, New Mexico, Hot Dry Rock Site. A series of tests have also been developed for measuring the resultant data quality, and this report describes these tests and applies them to evaluate the procedure. A test for measurement accuracy shows that locations were measured to better than 0.1 ft and orientations to within 1°. The root-mean-square error in fitting a trace rarely exceeded 0.2 ft. The second set of tests, for reproducibility, measures the amount of association between two different runs of the same length of hole, in this case a distance of 275 ft. Two new measures of association are defined, termed coplanarity and collinearity. The lack of any recurrences requires explanation and leads to a third set of tests, for repetition rate. The low repetition rate is explained by random errors in location and orientation, which are different on each run. A fourth set of tests consists of fitting a model of the feature-extraction process to the data and estimating data reliability from quality parameters of the model. A perception model yielded an estimate of data quality at 91.5%.

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 14087, 14090

14474 **(PB—88-146238/XAB) Report to Congress: management of wastes from the exploration, development, and production of crude oil, natural gas, and geothermal energy. Volume 2. Geothermal energy.** (Versar, Inc., Springfield, VA (USA)). Dec 1987. 155p. NTIS, PC A08/MF A01.

See also Volume 1, PB—88-146220, and Volume 3, PB—88-146246; Portions of this document are not fully legible. Also available in set of 4 reports PC E99, PB—88-146212.

Section 3001(b) (2) (A) of the 1980 Amendments to the Resource Conservation and Recovery Act (RCRA) temporarily exempted several types of solid waste from regulation under the Federal hazardous-waste control program. These exempted wastes included drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil or natural gas or geothermal energy. Section 8002(m) of the RCRA

Amendments requires EPA to study these wastes and submit a final report to Congress. This report responds to those requirements. It includes: (1) a description of the geothermal energy industry, including description of geothermal resources; (2) identification and characterization of geothermal energy wastes; (3) descriptions of waste management practices; (4) assessment of risks associated with geothermal operations; (5) descriptions of current regulatory programs; (6) conclusions and recommendations; and (7) a bibliography of references.

1509 Geothermal Engineering

14475 (SAND—85-1922) An experimental investigation of the hydrodynamic and heat-transfer behavior of aqueous foam in laminar tube flow. Blackwell, B.F.; Sobolik, K.B. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004954/JAW.

The structure of both static and dynamic aqueous foam samples has been observed photographically. Velocity profiles for a pipe-flow configuration were measured using a hot-film anemometer and an indirect calibration method. Temperature profiles at the end of a 3-m-long test section were measured using a thermocouple probe on a traversing mechanism. A finite-control-volume model of the energy equation for the flowing foam and the surrounding pipe was developed and compared with experimental results.

1510 Direct Energy Utilization

14476 (STF—36A86095) Geothermal wells at Steinkjer. Moseid, T.; Haarstad, K. (SINTEF, Trondheim (Norway)). Dec 1986. 40p. (In Norwegian). NTIS (US Sales Only), PC A03. Order Number DE88751122/JAW.

The report concerns an evaluation of a tubular well for heating purposes in Steinkjer (Norway). The plant behaviour together with the geologic conditions such as the permeability and filtering properties of the soil are investigated. The power output of the plant is found to be about 50 KW. 10 drawings.

1520 Geothermal Data And Theory

14477 Limits to magma mixing based on chemistry and mineralogy of pumice fragments erupted from a chemically zoned magma body. Vogel, T.A.; Ryerson, F.J.; Noble, D.C.; Younker, L.W. (Michigan State Univ., East Lansing). *Journal of Geology;* **95**: No. 5, 659-670(Sep 1987).

The chemical variation among pumice fragments from the Pahute Mesa Member of the Thirsty Canyon Tuff (Black Mountain volcanic center, southwestern Nevada) is consistent with magma withdrawal from a chemically zoned magma body. The top of this magma body contained little chemical variations, the lowest concentration of light REEs, and the highest concentrations of SiO_2, heavy REEs, and Th. The pumice fragments derived from the top of the magma body contain nearly pure ferrohedenbergite and fayalite. The next discrete zone in the magma body contained lower SiO_2, heavy REEs, and Th concentrations, and very high concentrations of light REEs. The lowest erupted layer contained relatively low concentrations of SiO_2, Th, and light and heavy REEs. Pumice fragments with polymodal disequilibrium phenocryst populations are a priori evidence of magma mixing. The magma mixing process is constrained by: the systematic vertical distribution of chemically distinct pumice fragments throughout the ash-flow sheet; the presence of disequilibrium phenocrysts within some pumice fragments in all but the lowermost part of the sheet; and the presence of compositionally uniform glass in most pumice fragments, including those with widely varying phenocryst compositions. Negligible mixing occurred at the top of the magma body; limited mixing occurred in the second and third layers. Because mixing did not destroy the original layering, the amount of guest magma must have been small. In order for unzoned disequilibrium phenocrysts to not become zoned, they must have been preserved in the magma body only a short time. And yet, in order to produce the homogeneous liquid that surrounds these phenocrysts, mechanical mixing must have been very efficient. 44 references.

14478 Mixing properties of $NaAlSi_3O_8$ melt-H_2O: new calorimetric data and some geological implications. Clemens, J.D.; Navrotsky, A. (Arizona State Univ., Tempe). *Journal of Geology;* **95**: No. 2, 173-186(Mar 1987). Contract AC02-80ER10765.

The authors present the results of direct calorimetric determinations of the heat of mixing of $NaAlSi_3O_8$ and H_2O to form hydrous melts and glasses. ΔH is small and exothermic throughout the P-T range investigated. At 298 K and 1 bar there is a minimum in ΔH (-2.39 kcal/mole at X/sub w//sup m/ $\approx$ 0.27). Results of high-pressure drop calorimetry on hydrous albite melts show that ΔH becomes more endothermic as T increases. The minimum in ΔH as a function of X/sub w//sup m/ occurs in the compositional region where OH^- is the dominant hydrogen-bearing species in the glass. The average partial molal heat capacity of H_2O in hydrous albite melt (from 298 to 1306 K, 20 cal/mole/K) is similar to that of pure liquid water at ambient conditions. Reconnaissance studies in the system 4Q-Ab-Or-H_2O indicate a general similarity with the Ab-H_2O system in that ΔH is small and exothermic. In detail, however, Ab-H_2O provides neither a quantitative nor a qualitative model for the more complex haplogranite melts. At 298 K, ΔH for the studied haplogranite composition is at a minimum of -0.75 kcal/mole at X/sub w//sup m/ $\approx$ 0.5. Their results help to explain geological phenomena such as the high water contents of perlitic obsidians and the lack of thermal magma quenching accompanying exsolution of dissolved water in explosive volcanic eruptions.

16 TIDAL AND WAVE POWER

1607 Tidal Power Plants

14479 (YR—3301) Steel caissons for the Severn Barrage. Phase 1. Updated designs and costs. (Y-ARD Ltd., Glasgow (UK); Roxburgh and Partners, Glasgow (UK)). Jun 1987. 66p. (Y—2934; ETSU-STP—4046(P1)). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Updates YM—4223.

The YARD/ROXBURGH study updates the previous study (YARD Memorandum No. 4223 dated 1 June 1984) to take account of recent work carried out by STPG and contained in their report (Tidal Power from the Severn - Vol IIA) published in 1986. These changes include barrage alignment and turbine numbers and diameters. In addition the sluice caissons have been redesigned to accommodate venturi not radial gate sluices. The 'sluice over turbine' caissons have not been considered. Plain caissons have been designed. The construction and installation costs have been revised to take account of the changes in design, and alignment and are to the same base date (January 1984) as used by STPG. The total cost of construction of a tidal barrage on the Cardiff Western line could be reduced by Pound 726 million, or 14.2%, if steel caissons were used rather than concrete caissons.

14480 (YR—3302) Steel caissons for tidal power barrages. Phase 2. Cost model. (Y-ARD Ltd., Glasgow (UK); Roxburgh and Partners, Glasgow (UK)). Jun 1987. 77p. (Y—2934; ETSU-STP—4046(PZ)). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The purpose of this study was to produce a computer cost model that would help ETSU to make a quick preliminary estimate of the viability of any site as a Tidal Power Barrage. The work undertaken for this study was to produce a computer cost model for capital cost of the complete barrage civil works using steel caissons. The assessment of the number of turbines, their diameter, rated power and amount of power generated together with the number and size of sluices required are matters that are independent of the method of construction used for the barrage. In consequence these items have been excluded from the cost model.

17 WIND ENERGY

1701 Availability (climatology)

14481 (NZERDC—140) Wind energy resource survey of New Zealand: National resource assessment, Summary and final report. Cherry, N. (Lincoln Coll., Canterbury (New Zealand). Dept. of Agricultural Engineering). Jun 1987. 56p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900356/JAW.

This report summarizes the national wind energy resource survey of New Zealand based on previous reports and using updated information. New Zealand has an extensive wind energy resource because of its location in the Southern Hemisphere zone of mid-latitude westerlies and its topography. Wind data from the New Zealand Meteorological Service formed the prime data base, supplemented by regional surveys in Canterbury and Otago, and wind profile data from 7 sites. A standard height of 50 m AGL, scaling reference height of 125 m and exposed site roughness length of 0.01 m were chosen in order to estimate the well-exposed mean wind speed at 50 m AGL for each site.

14482 (PNL-SA—15102) Caribbean and Central America wind energy assessment. Elliott, D.L. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 9p. (CONF-871062—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005134/JAW.

From Windpower '87; San Francisco, CA, USA (5 Oct 1987).

A wind energy resource assessment of the Caribbean and Central America, based on available data and using innovative assessment techniques developed for this region, has identified many areas with good to outstanding wind resource potential. This paper provides an overview of the Caribbean an Central America wind resource assessment and the data and techniques used in producing the assessment. Wind resource maps were developed for 35 island/country areas throughout the Caribbean and Central America. These maps highlight the locations of major resource areas and provide not only estimates of the wind energy resource potential for well-exposed sites in these areas at also information on the frequency distribution of the wind speeds (expressed as estimates of the Weibull shape factor, k) and seasonal variations in the wind resource. The average energy in the wind flowing in the layer near the ground is expressed as a wind power class: the greater the average wind energy, the higher the wind power class. A diagram was developed for easily relating the wind power classes and Weibull k values to values of mean wind power density and mean wind speed.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 14481

14483 (CONF-861062—Vol.1) Proceedings of the European Wind Energy Association Conference and Exhibition (EWEC'86): Volume 1. Palz, W.; Sesto, E. (eds.). (Commission of the European Communities, Brussels (Belgium); Ente Nazionale per l'Energia Elettrica, Rome (Italy)). 1986. 653p. NTIS (US Sales Only), PC A99. Order Number DE88900295/JAW.

From European wind energy conference; Rome, Italy (7 Oct 1986).

The proceedings of the European Wind Energy Conference are presented. Papers have been separately indexed for this first of two volumes. (BCS)

14484 (CONF-861062—Vol.2) Proceedings of the European Wind Energy Association Conference and Exhibition (EWEC'86): Volume 2. Palz, W.; Sesto, E. (eds.). (Commission of the European Communities, Brussels (Belgium); Ente Nazionale per l'Energia Elettrica, Rome (Italy)). 1986. 585p. NTIS (US Sales Only), PC A25. Order Number DE88900306/JAW.

From European wind energy conference; Rome, Italy (7 Oct 1986).

The proceedings of the European Wind Energy Conference are presented. Papers have been separately indexed for this second of two volumes. (BCS)

14485 (ETSU-WN—5071/1) Further fatigue and structural analysis of the 20 m wind turbine generator. Orkney project. Haines, R.S. (ed.). (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Feb 1987. 273p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Four contributions to the analysis of fatigue and structural loading of a Wind Turbine Generator are presented, using experimental data from the Wind Energy Group's MS-1 (250kW, 20m diameter) machine. Nearly 200 five minute blocks of archived raw data have been validated, and catalogued in detail according to the environmental and operational conditions over the period of capture. Records of blade bending strain under four different conditions have been processed to eliminate the periodic component. The resulting data can be used to test predictions of stochastic blade loads arising from turbulence. Records of steady tower bending strain have been processed to eliminate drift. Dynamic tower strains have also been analysed, and show the expected characteristics apart from the unexpectedly large component at the '1P' frequency. Comparisons have been made between the results of a number of different data reduction techniques for blade strain data.

14486 (LI—581/87) Noise from small wind mills. Guide to reduction of noise from wind mills. Ohlrich, M.; Jakobsen, J.; Andersen, B. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Akustik; Lydteknisk Inst., Lyngby (Denmark); DK-Teknik, Soeborg (Denmark)). Sep 1987. 62p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751143/JAW.

Wind mills are usually placed in areas with a low level of background noise. Noise from wind mills have environmental impacts, which can have a slowing effect on the extension of wind energy. The development of less noisy wind mills is therefore of great importance because it makes it possible to use the sites better without deteriorating the environment. The purpose of this guide is to help a development of new comparatively noiseless wind mills by : describing the cause of the noise and illustrate what elements have an influence on this noise - giving guidelines for choosing components, noise specification, design of the rotor, and suggestions to noise reducing measures. Within the last few years the noise from small mass produced wind mills of comparative size, has been reduced with about 5 dB. (SM). 16 refs.

14487 (PNL-SA—15103) Site effects on wind characteristics at a turbine rotor. Connell, J.R.; Powell, D.C.; Morris, V.R. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 7p. (CONF-871062—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005135/JAW.

From Windpower '87; San Francisco, CA, USA (5 Oct 1987).

Enough measurements of wind characteristics at two different types of turbine sites have now been completed to support a useful preliminary description of the effect of a site on the wind. This paper discusses the effect of terrain, with minimal reference to atmospheric static stability and other processes, on the wind at two sites. The turbulent wind at each site was measured with a set of anemometers equally spaced in a crosswind circular array. Turbulence intensities range from less than 0.10 to greater than 0.25. Time series of wind speed at each site are characterized in both the Eulerian coordinate system and the rotating system of the turbine rotor. A straightforward rotational sampling of wind measurements is used with each vertical plane array (VPA). The differences in turbulence characteristics are discussed in relation to the complexity of the site terrain. The potential impact on a rotor is discussed briefly. The primary turbulence properties of importance in determining rotor blade forcing, energy, and size of turbulence eddies carrying most of the energy are found to vary substantially. The conclusions are tentative and suggest a plan of research that promises to most effectively provide a practical model of the effect of terrain on the turbulent wind characteristics and thus on the fluctu-

ating response of wind turbines as a function of the site characteristics.

14488 **(SERI/TP—217-3269) Turbulence loads on the Howden 26-m-diameter wind turbine.** Madsen, P.H.; Hock, S.M.; Hausfeld, T.E. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1987. Contract AC02-83CH10093. 12p. (CONF-880132—4). NTIS, PC A03; 3; GPO Dep. Order Number TI88001118/JAW.

From 7. wind energy symposium; New Orleans, LA, USA (10 Jan 1988).

Conducted in Palm Springs, California, a joint effort between SERI and James Howden and Company involved a comprehensive test program on the 330-kW Howden wind turbine with a three-bladed, fixed-hub rotor 26 m in diameter. Part of the measurement analysis is to quantify the turbulence loads during the steady-state production modes of operation. Assuming wind turbulence to be the cause of the random loads, the turbulence loads in terms of blade root-bending moments have been determined empirically by isolating the random or nonperiodic part of the load signals using azimuthal averaging. Standard deviations as functions of wind speed, as well as power spectra of the loads, are presented. The measured turbulence loads are compared to a recently developed model for turbulence loading of wind turbines. The model works in the frequency domain and uses the standard engineering representation of turbulence in terms of a coherence function and a wind-power spectrum at a fixed point in space. The turbulence load model accounts for the dominant mode of vibration for the load in question and is intended to be simple enough to be used for a preliminary load estimate for practical design purposes.

14489 **Wind power. DOE contracts.** *Alternative Sources of Energy;* No. 93, 43(Sep 1987).

The DOE has awarded five contracts totaling $405,000 under its Cooperative Research Program for Wind Energy Systems. The companies selected will complete research programs under a cost-sharing basis with the DOE. The focus of the program is on wind-diesel hybrid systems, wind-electric water pumping, and wake effects of wind machine and wind project spacing. The companies selected under the program are: Atlantic Orient Corp. of Norwich, Vermont, to study system stability and penetration for wind-diesel systems; Bergey Windpower Co. of Norman, Oklahoma, to study testing and analysis of small wind-electric pumping systems; Fayette Manufacturing Corp. of Tracy, California, to measure variable-distance wake effects utilizing a roving wind turbine; Northern Power Systems of Moretown, Vermont, to study the development of improved wind-diesel systems using battery storage; and US Windpower of Livermore, California, to study macroscale effects on the ambient wind speed of an upstream windfarm.

20 ELECTRIC POWER ENGINEERING

14490 **(CONF-880219—1) A methodology to assess the effects of high altitude electromagnetic pulse (HEMP) on electric power systems.** Taylor, E.R. Jr.; Eichler, C.H.; Barnes, P.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.; Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000338/JAW.

From IEEE winter power meeting; New York City, NY, USA (2 Feb 1988).

Nuclear electromagnetic pulse (EMP) from high altitude nuclear detonations (HEMP) has the potential to seriously disrupt electric power systems. A methodology has been developed to assess the vulnerability of electric power systems to this phenomena for any specified nuclear burst scenario. The methodology is based on a structured approach whereby the power system is broken down into subsystems, functional groups, and circuits and devices. Vulnerability (likelihood of failure) is assessed for individual equipment (circuits and devices) for each nuclear burst scenario. These effects are then evaluated for their performance impact on successively higher system levels. This forms the input for classical load flow, short circuit and transient stability studies to evaluate system stability and survivability. Applicability of the assessment methodology is not dependent on the quality of component/equipment vulnerability data. Susceptibility of power equipment to HEMP damage may be determined by established technical analysis, by interpretation of equipment design and testing standards, and by laboratory testing. This paper has been written not only for the electric utility engineer, but also for experts in EMP who may not be knowledgeable in electric utility systems. 12 refs., 11 figs., 1 tab.

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 13928, 13929, 13940, 13942, 13974, 14021, 14024, 14033, 14504, 14506, 14506, 14508, 14707, 14758, 14872, 15685

14491 **(EPRI-AP—5550) DYNASTORE: A computer model for quantifying dynamic energy storage benefits: Interim report.** Lee, S.T. (Electric Power Consulting, Inc., Santa Clara, CA (USA)). Dec 1987. 134p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920120/JAW.

Dynamic Benefits are various operating cost savings that have not been adequately modeled in production costing programs used in system planning. The most significant of these dynamic benefits can be classified under the following areas of system operating requirements: (1) operating and spinning reserve, (2) load following, and (3) unit commitment. The objective of this report is to present a computer model called DYNASTORE which is designed to estimate these dynamic benefits of energy storage. It is a chronological dispatch model of a 24-hour period using a time step of 10 minutes. It is user-friendly and is implemented on the IBM Personal Computer or a compatible computer. 12 figs., 18 tabs.

14492 **(EPRI-CS—4780) Strategy for fossil plant life extension at Niagara Mohawk's Huntley-67: Final report.** (Niagara Mohawk Power Corp., Syracuse, NY (USA); Ebasco Services, Inc., New York (USA); Combustion Engineering, Inc., Windsor, CT (USA); General Electric Co., Schenectady, NY (USA)). Jan 1988. 394p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920158/JAW.

The evaluation was based on the Niagara Mohawk Power Corporation's "Fossil Life Extension Program Plan" which outlines the philosophy and methodology for life extension of Niagara Mohawk Power Corporation's existing fossil units and includes unit selection or prioritization, selection of equipment for evaluation, equipment evaluation with respect to remaining useful life, and economic evaluation of life extension options. This report describes the criteria used to select (prioritize) C.R. Huntley Unit 67 as the first of NMPC's units to undergo a life extension evaluation. Sixteen (16) fossil fired units were ranked, with the general philosophy of order, better performing units given preference, on the basis of age, size, design vintage, availability, heat rate, fuel cost, operating and maintenance costs, levelized replacement cost and utilization factor to prioritize their evaluations. Equipment and components were selected for evaluation on the basis of safety, unavailability of spare parts or long lead time of a year or more to obtain critical components, potential to cause full or partial unit outage, potential for imminent failure or chronic problem and reliability or performance deterioration. During a scheduled major unit outage in June and July 1985, the selected equipment was examined using various nondestructive techniques and metal sampling. 37 figs., 64 tabs.

14493 **(EPRI-CS—5585) Creep crack growth in boiler and steam pipe steels: Topical report.** Saxena, A.; Han, J.; Banerji, K. (GA Technologies, Inc., San Diego, CA (USA); Georgia Inst. of Tech., Atlanta (USA). Fracture and Fatigue Research Lab.). Jan 1988. 37p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920151/JAW.

One of the important ingredients in remaining creep crack growth life assessment of heavy section elevated temperature power plant components is the material creep crack growth rate data. This report summarizes the currently available data on Cr-Mo and Cr-Mo-V steels most commonly used in steam pipes and boilers. All data are correlated with the crack tip parameter, C/sub t/. The accompanying creep deformation data and tensile properties

are also included. The influence of in-service degradation, test temperature and the welding parameters such as impurity level and post weld heat treatment (PWHT) on the creep growth behavior were examined. It was shown that the influence of nominal material chemistry, service degradation and test temperature can be normalized into a single da/dt versus C/cub t/ trend for the base materials. It was also shown that the level of impurities and the PWHT can significantly influence the da/dt versus C/sub t/ behavior in weldments. 17 refs., 10 figs.

14494 **(EPRI-CS—5588-Vol.2) Remaining-life estimation of boiler pressure parts: Volume 2, Miniature specimen creep testing: Final report.** Askins, M.C.; Marchant, K.D. (Combustion Engineering, Inc., Chattanooga, TN (USA); Central Electricity Research Labs., Leatherhead (UK)). Jan 1988. 37p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920164/JAW.

As part of an EPRI research project, "Remaining-Life Estimation of Boiler Pressure Parts," one of the objectives was the development of a miniature specimen preparation and test procedure for creep life assessment. Work undertaken at Central Electricity Research Laboratories (CERL) for this task is described. A method of manufacturing miniature tensile test specimens from small samples of material, using electron-beam welding to attach grip sections, has been devised and proven. For thick-walled components, the specimen size may allow the procurement of component samples without the need for weld repairs and postweld heat treatment. A set of machines for testing the specimens under a controlled atmosphere have been designed and commissioned. Good reproducibility of results is shown, and results consistent with those from conventional sized specimens are obtained. Comparison of results of tests performed on miniature specimens prepared from crept specimens interrupted at certain life fractions with independent checks, conforms the valid use of the technique in life assessment. The development of a miniature specimen testing facility provides an excellent means of conducting accelerated temperature post-exposure life assessment programs. The technology developed during the course of this work is used extensively in the British power generation industry. It is considered that the development and implementation in the United States would be a major benefit to American utilities. 20 refs., 15 figs., 4 tabs.

14495 **(EPRI-CS—5589) Effects of selected water treatments and cathodic protection on corrosion and embrittlement of condenser tubes: Final report.** (Ocean City Research Corp., NJ (USA)). Jan 1988. 201p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920156/JAW.

This report summarizes the results of a three-year laboratory study investigating: (1) the interaction and effect of sulfide, dissolved oxygen, and temperature on the corrosion of copper alloy condenser tubes; (2) the effectiveness of selected cooling water treatments in mitigating sulfide-accelerated corrosion; (3) the effects of various parameters on the hydriding susceptibility of titanium tubing under cathodic protection conditions; and (4) the hydrogen embrittlement susceptibility of ferritic stainless steels under cathodic protection conditions. The selected cooling water treatments included ferrous sulfate, benzotriazole, sodium dimethyl dithiocarbamate, high molecular weight polyacrylamide, and Calgon CL-5. Much of the work was carried out utilizing seawater test loops designed to simulate condenser tube flow. The results of the study demonstrated that: (1) sulfide contamination of a copper alloy condenser tube can trigger rapid perforation of the tube; (2) ferrous sulfate treatement may be effective in mitigating sulfide-accelerated attack if initiated prior to and during any sulfide exposure; and (3) cathodic protection at high electronegative potentials will embrittle titanium and ferritic stainless steel condenser tubes. The report recommends further research directed at: (1) the long-term effectiveness of ferrous sulfate treatement in retarding sulfide-promoted pitting; (2) corrosion-accelerating mechanisms associated with chlorination and silt build-up; (3) an appropriate method for cleaning condenser tubes contaminated with a corrosion accelerant; (4) a more effective method of on-line monitoring of condenser tube corrosion; and (5) an update of recent electric utility experience concerning corrosion of copper alloy condenser tubes. 32 refs., 39 figs., 10 tabs.

14496 **(EPRI-CS—5601) Engineering assessment of condenser deaeration retrofits for cycling fossil plants: Final report.** Oliker, I.; Silaghy, F.; Lessley, R. (Burns and Roe Enterprises, Inc., Oradell, NJ (USA); Bechtel National, Inc., San Francisco, CA (USA)). Jan 1988. 110p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920161/JAW.

High dissolved oxygen levels in the condensate feedwater system contribute significantly to corrosion problems in steam generators, turbine rotor and blading, feedwater piping, feedwater heaters, and other plant equipment. While ingress of oxygen and oxidizing species into the condensate feedwater system cannot be completely eliminated due to a large number of potential air inleakage paths including air in-leakage into the condensate in the hotwell section of the condenser, oxygen levels could be kept to a minimum even at partial and no-load operation by improved condensate deaeration. The corrosion problems encountered in PWR plants, as well as those causing increased maintenance requirements and plant deterioration in cycling fossil plants are growing concerns to utilities. These concerns have motivated EPRI to investigate the causes and to seek remedies for the high dissolved oxygen levels that occur at start-up, low operating loads and shutdown. The purpose of this project was to develop the design, install and test three independent systems that could serve to reduce and maintain the low, dissolved oxygen content in the condensate of a peaking fossil unit under all operating conditions. If the results of the tests are favorable, the devices could be used at other peaking fossil plants and nuclear plants. 5 refs., 28 figs., 7 tabs.

14497 **(NP—8751687) Calculation of steady state and low frequency transient flow in an end-stage of a steam turbine.** Lattermann, R. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Thermische Stroemungsmaschinen und Maschinenlaboratorium). 1986. 129p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751687/JAW.

A numerical process of solution for calculating nonsteady state frictionless turbine flows in the transonic speed range is described. Assuming rotation symmetrical flow layers between the blades, variable layer thicknesses in the axial direction and their changeable spacing from the axis of rotation are taken into account in the model. Using the example of a low pressure steam turbine, the calculation of the flow field of an end stage with steady state and low frequency pulsating flow, caused by an asymmetrical pressure field in the outflow cross section, is carried out. This asymmetry of the outflow behaviour leads to the excitation of vibration in the last ring of moving blades in the frequency range of the lower natural frequency and can therefore represent a danger for the safe operation of turbines.

14498 **(VTT-TIED—718) Prefeasibility study on small-scale cogeneration plants.** ElMahgary, Y.; Sipilae, K.; Pihala, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). May 1987. 56p. NTIS (US Sales Only), PC A04. Order Number DE88751091/JAW.

The technical aspects of small-scale cogeneration plants were outlined. The parameters affecting their economy were discussed. The economics of both SCP (Small Cogeneration Plants 1-20 MW/sub (e)/ and MCP (Mini COgeneration Plants < 1 MW/sub (e)/ was estimated using tariffs and costs valid in Finland. Two typical case studies were also considered. The result has demonstrated that both (SCP) Small Cogeneration Plants (1-20 MW/sub e/) and (MCP) Mini Cogeneration Plants (less than 1 MW/sub e/) are generally competitive in comparison to other conventional methods of producing electricity and heat. In case of SCP the electricity tariff in force is the factor which has the most pronounced role in their economics. This is also true in case of MCP, however, the district heat tariff and the type of fuel used in the boiler have similar pronounced effects in case of MCP. Upon escalation of oil process the c the competitiveness of SCP and MCP using natural gas improves.

14499 **Materials selection for abrasive duty.** *Materials and Components in Fossil Energy Applications;* No. 67, 9-10(1 Apr 1987).

The abrasion of equipment caused by the throughput of large volumes of solids or dust is a major problem in mining, han-

dling and processing minerals such as coal and limestone, and in the disposal of waste products such as ash. Loss of material from the surfaces over which these materials pass is caused by the combined effects of impact abrasion, sliding abrasion, and chemical attack. Factors which affect these processes include properties of the conveying medium, and properties of the solids, such as particle size, structural composition, size mix, as well as the velocity of the material, the bulk volume of material passing, and the frequency of plant operation. Guidelines are given for materials selection and the use of linings in the coal handling plant, pulverized coal pipework, and ash disposal plant is reviewed for coal-fired power plants.

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 13964, 13965, 13969, 13973, 13974, 14020, 14636, 15524, 16044, 16045, 16096

14500 (DOE/MC/10637—2414-Vol.1, pp 1-69, Paper 1) **Simultaneous SO/sub x//NO/sub x/ control: Final technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March 1987.** Weber, G.F.; Collings, M.E.; Schelkoph, G.L.; Steadman, E.N. Apr 1987. NTIS, PC A12/MF A01. Order Number DE87006531/JAW.

In Low-rank coal research: Volume 1, Control technology, liquefaction, and gasification: Final report.

The overall project objective is to expand the scientific and engineering data base necessary for the development of innovative processes for the control of SO/sub x/ emissions during coal combustion. Investigation of dry sorbent injection concepts for SO/sub x/ control and methods of enhancing SO/sub x/ sorbent reactivity/utilization were considered in this project. Sorbent evaluation activities in the first year included a literature review of calcium-based sorbent characteristics and evaluation of two limestones and their respective calcination and hydration products. The literature review addressed sorbent characteristics with respect to flue gas desulfurization processes with emphasis on furnace injection technology. Results of the experiments showed that the commercial hydrate resulted in better sorbent utilization than the limestone or lime for both the Marblehead and Longview materials. Hydration experiments conducted to determine the impact of pressure and water stoichiometry on sorbent reactivity were not statistically significant. Therefore, for hydration pressures and water stoichiometries ranging from 50 to 180 psig and 1.0 to 1.6, respectively, no change in hydrate reactivity with respect to SO_2 was observed during pilot-scale furnace injection tests. 29 refs., 28 figs., 24 tabs.

14501 (DOE/MC/10637—2414-Vol.2, pp 1.1-7.4, Paper 6) **Flue gas conditioning for improved fine particle capture in fabric filters: Comparative technical and economic assessment: Final technical report for fine particulate emissions for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March 1987.** Miller, S.J.; Laudal, D.L. Apr 1987. NTIS, PC A20/MF A01. Order Number DE87006532/JAW.

In Low-rank coal research: Volume 2, Advanced research and technology development: Final report.

The process of flue gas conditioning applied to fabric filtration involves the injection of small amounts of ammonia and SO_3 into the flue gas, upstream of the baghouse. Results show substantial reductions in fine particulate emissions with this method. For several coals which produce difficult-to-collect ashes, particulate emissions were reduced by up to four orders of magnitude. This represents an increase in particulate removal efficiency from 90% to 99.999%. Tests with both lignite and higher rank coal show that conditioning is an effective method of greatly reducing fine particulate emissions from a fabric filter. As a bonus, results show that baghouse pressure drop is also reduced, making the process even more attractive. Since injection technology for conditioning agents has been well developed for use with electrostatic precipitators, this method is readily available. Longer term and larger scale testing, however, is needed to more fully evaluate the potential of conditioning agents to improve fabric filter performance. Possible applications of flue gas conditioning applied to fabric filtration include immediate retrofit applications where emissions or pressure drop are higher than acceptable and future retrofit or new plant applications to meet stricter control regulations.

14502 (MEWSH/ECS—MG/8159) **Brandon Thermal Generating Station particulate emissions from the breeching of power boiler unit 5, 1986.** (Manitoba Dept. of Environment and Workplace Safety and Health, Winnipeg (Canada). Environmental Control Services). 6 May 1987. 67p. (MICROLOG—87-05991). Manitoba Environment and Workplace Safety and Health, 450 Broadway Ave., Room 156, Legislative Bldg., Winnipeg, Man., Canada R3C 0V8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

During 1986 two source emission surveys were conducted on boiler Unit 5 at Manitoba Hydro's Brandon Thermal Generating Station. The average concentration of particulate matter at the Unit 5B breeching, when corrected to 12 percent CO/sub 2/, was 3.83 grams per dry standard cubic meter (g/dscm) for the fist survey and 1.99 g/dscm for the second survey. In 1986 the Brandon Station was utilized for peak load requirements only when other sources of power were not available. Particulate testing indicated emissions were higher than the limit of 0.57 grams/dscm (corrected to 12% CO/sub 2/) stipulated in Clean Environment Commission Order No. 1039. However, as annual electrical power generation was less than the 500,000 megawatt hours specified, the Brandon Thermal Generating Station was not in violation of the Order. 6 figs., 8 tabs.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 16102

14503 (BNL—40420) **The status of R & D for superconducting power transmission systems.** Forsyth, E.B. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 10p. (CONF-8710244—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003499/JAW.

From Workshop on utility applications of superconductivity; Washington, DC, USA (22 Oct 1987).

Many research groups in the US, Europe and the USSR worked on the development of superconducting power transmission systems in 1960's, 1970's and early 1980's. The superconducting material used was niobium or niobium-tin. A wide variety of conductor configurations, dielectric insulation and cryogenic enclosures were investigated. Systems studies to evaluate technical and economic factors were performed. Two large outdoor test facilities were constructed which provided data of interest to potential utility company users. Virtually all these projects are now closed down, mainly due to technical difficulties with the particular design chosen or due to the realization that the next development phase, the transfer of the technology into industry, will be very expensive compared to the original R & D costs. At present no funding agency sets a high priority on the development of superconducting power transmission systems. 20 refs., 3 figs., 5 tabs.

14504 (CONF-880219—2) **Impact of automation on the reliability of the Athens Utilities Board's distribution system.** Monteen, L.D.; Lawler, J.S.; Lai, J.S.; Patton, J.B.; Rizy, D.T. (Athens Utilities Board, TN (USA); Tennessee Univ., Knoxville (USA); Patton (J.B.), Knoxville, TN (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02. Order Number DE88002690/JAW.

From IEEE winter power meeting; New York City, NY, USA (2 Feb 1988).

In this paper we discuss the reliability effects of distribution automation on the Athens Utilities Board (AUB) in Athens, Tennessee. This investigation is part of the Athens Automation and Control Experiment sponsored by the US Department of Energy, Office of Energy Storage and Distribution, Electric Energy Systems Program. In this experiment, distribution feeder equipment on twelve feeders connected to three substations is being remotely controlled from a central dispatch center. A supervisory control and data acquisition system provides substation and feeder monitoring and remote control of feeder circuit breakers, power reclosers, and load break switches. An analytical study is presented to show

the improvement in conventional distribution system reliability indices that are achieved at AUB as a function of the penetration of automation equipment. The value of automation predicted by the study is highly sensitive to the historical outage data used in the analysis and to the economic worth of reliability assigned by the utility. These sensitivities are well known and account, at least in part, for the reluctance of some upper utility managers to invest in automation systems. Operating experience with the AUB automation system has shown that there are significant intangible reliability benefits and tangible cost savings associated with automation that are outside the scope of conventional distribution reliability indices. Eight case studies are described, from actual AUB operations, where the automation system resulted in significant cost savings and reliability benefits that are not captured by conventional reliability indices. Other utilities should expect similar benefits, which will be difficult to quantify analytically but, which add to the value of and justification for distribtuion automation. 4 refs., 3 figs., 4 tabs.

14505 **(EFI-TR—3372) Local control in the distribution network.** Kjelkenes, O.; Bjoerlykke, G.; Finnset, T. (Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)). Nov 1986. 83p. (In Norwegian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751218/JAW.

The report specifies functions for an automatic operating power distribution network. The functions needed for the connection of reconditioned systems to the operating network are discussed in particular. In addition, the report describes a method to schedule functions of local units, and which type of data to be needed in the centralized data base. The information processing is to be done by mean of the computer program NETBAS. 28 drawings.

14506 **(EPRI-EL—5290) Composite-system reliability evaluation: Phase 1, Scoping study: Final report.** Bhavaraju, M.P. (Public Service Electric and Gas Co., Newark, NJ (USA)). Dec 1987. 185p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920126/JAW.

The objectives of this work were to explore the philosophy of composite generation and transmission system reliability evaluation, identify suitable reliability indices and models for their computation, and evaluate the solution accuracy requirements. The project team obtained valuable inputs from the utility industry through meetings and a questionnaire. The majority of utilities are following the industry developments with interest. Some utilities have indicated strong interest in the development of methods for composite system reliability evaluation that include "realistic" operating constraints and produce meaningful indices. Composite system reliability evaluation is important because the contribution of the combined generation and transmission contingencies to the system unreliability could be significant. Also, such an evaluation is necessary whenever the study requires a trade-off between generation and transmission system needs. This report defines the concept of composite system reliability and describes the research needs to develop practical composite system reliability evaluation tools. 13 refs., 14 tabs.

14507 **(EPRI-EL—5478) Shield losses in medium-voltage cables: Final report.** Silver, D.A.; Buckweitz, M.D. (Silver (David A.) and Associates, Inc., Livingston, NJ (USA)). Dec 1987. 99p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920122/JAW.

Shield circulating current losses and cable ampacities have been calculated for five aluminum conductor sizes of 15kV and 25kV distribution cables, each cable having a concentric copper wire shield/neutral conductor of the size and number of wires corresponding to approximately 1/3, 1/6, 1/8 and 1/10 the circular mil area of the phase conductor adjusted for conductivity of the two metals. Calculations were performed for single conductor cables in close triangular and in flat configurations, in the latter case for 7.5 inch and 12 inch spacings between cable centers. Calculations were also performed for three basic double circuit configurations, one with the cables in close triangular configuration with the two circuits spaced 18 inches apart, the second with the six cables in flat configuration with the cables spaced 7.5 inches and 12 inches on centers, respectively, and 24 inch spacing between the nearest cables of the two circuits, and the third with the six cables in two layers of three, one directly above the other with 7.5 inch spacing between cables and between circuits and 12 inch spacing between cables and circuits, respectively. Circulating current losses were calculated for 100% of rated load based on 75% load factor for the circuit. This engineering study clearly demonstrates that shield losses and cable ratings can be optimized by coordination of cable design and the circuit configuration. A guide is presented which provides a step by step procedure for design of metallic shields based on sound engineering principals and for maximum cost effectiveness. 5 refs., 53 figs., 19 tabs.

14508 **Gaseous dielectrics V.** Christophorou, L.G.; Bouldin, D.W. (eds.). New York, NY; Pergamon Press (1987). 692p. (CONF-870516—). Pergamon Books, Inc., Maxwell House, Fairview Park, Elmsford, NY 10523. Order Number TI88004823/JAW. Contract AC05-84OR21400.

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

This symposium represents a transdisciplinary and comprehensive approach to the study of gaseous dielectrics. The goal of the symposium was to demonstrate the effective coupling between basic and applied research and modern technology achieved in this area, and to guide future research and development and industrial use of gaseous dielectrics. Separate abstracts were prepared for 85 papers in these proceedings. (DWL)

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REFER ALSO TO CITATION(S) 14589, 14750

14509 **(CEA-CONF—9032) Parallel diffusion calculation for the PHAETON on-line multiprocessor computer.** Collart, J.M.; Fedon-Magnaud, C.; Lautard, J.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Apr 1987. 14p. (CONF-870424—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751342/JAW.

From American Nuclear Society international meeting on advances in reactor physics, mathematics and computation; Paris, France (27 Apr 1987).

The aim of the PHAETON project is the design of an on-line computer in order to increase the immediate knowledge of the main operating and safety parameters in power plants. A significant stage is the computation of the three dimensional flux distribution. For cost and safety reason a computer based on a parallel microprocessor architecture has been studied. This paper presents a first approach to parallelized three dimensional diffusion calculation. A computing software has been written and built in a four processors demonstrator. We present the realization in progress, concerning the final equipment. 8 refs.

14510 **(DOE/ER/75172—4) 1987 American Nuclear Society: Eastern regional student conference: Transactions.** (American Nuclear Society, La Grange Park, IL). 1987. Contract FG02-85ER75172. 85p. (CONF-8704254—Absts.). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005040/JAW.

From Eastern regional student conference; Raleigh, NC, USA (3 Apr 1987).

This report is composed of the abstracts for papers presented at the 1987 American Nuclear Society Eastern Regional Student Conference. The abstracts are arranged by technical session and within a technical session in the order of presentation. The names of the sessions were advanced reactors and applications; computational methods; computational methods in fluid dynamics; fuel cycle and waste management; fusion engineering I and II; health physics; materials science; radiation transport, shielding, and radioisotope applications; reactor physics I and II; reactor safety; and thermal-hydraulics. (DWL)

14511 (EPRI-NP—5554) Plant Expert System (PLEXSYS): Prototype description, Version 1.0: Interim report. Laning, D.B.; Drummond, B.; Tanner, J.; Bock, C.; Kocher, K.; McNabb, M.; Gaiser, J. (Intellicorp, Mountain View, CA (USA)). Dec 1987. 103p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920146/JAW.

The August 1985 EPRI report on the Functional Specifications for AI Software Tools for Electric Power Applications (EPRI NP-4141) identified that the barrier to the introduction of artificial intelligence to the electric power industry was not lack of interest or appropriate problems, but rather the personnel with the necessary skills to integrate the methodologies from the fields of the nuclear power industry and computer science. The solution proposed to this problem was not to directly educate nuclear power personnel to become experts in other fields, but to provide tools that enable non-AI scientists to use AI methodology that is embedded in domain intensive work environments. This report describes the current state of the software engineering tool described in that document, a knowledge or model based reasoning system that provides nuclear power personnel the ability to build models of simple systems and run various analysis facilities which utilize information embedded within the model. At the core of this knowledge system is a model editor for graphically building schmatic descriptions of elementary components. Several utilities provide sophisticated analysis of these schematics, including network analysis, fault description and diagnosis of components, a math modeling facility, and advanced user interface aids.

14512 (INIS-mf—11034) VUPEK Newsletter 2/86. (Vyzkumny Ustav Palivoenergetickeho Komplexu, Prague (Czechoslovakia)). 1986. vp. (In Slovak). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780033/JAW.

Separate abstracts were prepared for the individual papers in this report.

14513 (NUREG—0020-Vol.11-No.10) Licensed operating reactors: Status summary report, data as of 9-30-87. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration and Resources Management). Oct 1987. 474p. NTIS, PC A20/MF A01 - GPO. Order Number TI88900230/JAW.

The OPERATING UNITS STATUS REPORT - LICENSED OPERATING REACTORS provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Administration and Resources Management from the Headquarters staff of NRC's Office of Enforcement (OE), from NRC's Regional Offices, and from utilities. The three sections of the report are: monthly highlights and statistics for commercial operating units, and errata from previously reported data; a compilation of detailed information on each unit, provided by NRC's Regional Offices, OE Headquarters and the utilities; and an appendix for miscellaneous information such as spent fuel storage capability, reactor-years of experience and non-power reactors in the US. It is hoped the report is helpful to all agencies and individuals interested in maintaining an awareness of the US energy situation as a whole.

14514 (NUREG—1290-Add.) Differing professional opinions: 1987 special review panel. (Nuclear Regulatory Commission, Washington, DC (USA)). Jan 1988. 7p. NTIS, PC A02/MF A01 - GPO. Order Number TI88900300/JAW.

In November 1987, the five-member Differing Professional Opinions Special Review Panel established by the Executive Director for Operations of the US Nuclear Regulatory Commission to review agency policies and procedures for handling differing professional opinions (DPOs) presented its findings and recommendations in NUREG-1290. The issuance of that report completed the first task of the panel's charter. In accordance with Manual chapter 4125, Section L, and the charter of the Special Review Panel, the panel's second task was to "...review...the DPOs submitted subsequent to the previous Panel's review, in order to identify any employee whose DPO made a significant contribution to the Agency or to the public safety but who has not yet been recognized for such contribution." This Addendum provides the findings of that review.

14515 (NUREG/CR—4690-Vol.1-No.1) Generic communications index: Listings of communications, 1971-1986. Dean, R.S.; Steinbrecher, D.H.; Hennick, A. (Parameter, Inc., Elm Grove, WI (USA)). Dec 1987. 319p. NTIS, PC A14/MF A01 - GPO. Order Number TI88900251/JAW.

As part of its program to feed back information on operating experience to industry, the US Nuclear Regulatory Commission (NRC) issues certain generic communications called bulletins (about 10/y), information notices (about 100/y), and circulars (now discontinued). The report presents an index of all such communications from 1971, when such documentation started, to 1986. The index is the printout from the computer database developed at the NRC for easy access to information previously published in these generic communications. The record (row) entries each consist of twenty fields (columns) of categorized information about a particular document. Included are fields for the document identification number, title, and NRC technical contact, and fields for general system or topic, specific component or topic, cause or defect, potential effect, remarks, and vendors involved. The report also contains lists of communications sorted by each subject category of the General System or Topic and the Specific Component or Topic fields. A list of the category subjects used and a list of vendors involved in the communications are included, also. The NRC intends to periodically update this report to index later communications.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 14177, 14358, 14622, 14638, 14653, 14657, 14667, 14668, 14677, 14682, 14690, 14691, 14693, 14696, 14699, 14700, 14701, 14767

14516 (CONF-8710111—26) Detection and characterization of flaws in segments of light water reactor pressure vessels. Cook, K.V.; Cunningham, R.A. Jr.; McClung, R.W. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004702/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Studies have been conducted to determine flaw density in segments cut from light water reactor (LWR) pressure vessels as part of the Oak Ridge National Laboratory's Heavy-Section Steel Technology (HSST) Program. Segments from the Hope Creek Unit 2 vessil and the Pilgrim Unit 2 Vessel were purchased from salvage dealers. Hope Creek was a boiling water reactor (BWR) design and Pilgrim was a pressurized water reactor (PWR) design. Neither were ever placed in service. Objectives were to evaluate these LWR segments for flaws with ultrasonic and liquid penetrant techniques. Both objectives were successfully completed. One significant indication was detected in a Hope Creek seam weld by ultrasonic techniques and characterized by further analyses terminating with destructive correlation. This indication [with a through-wall dimension of ~6 mm (~0.24 in.)] was detected in only 3 m (10 ft) of weldment and offers extremely limited data when compared to the extent of welding even in a single pressure vessel. However, the detection and confirmation of the flaw in the arbitrarily selected sections implies the Marshall report estimates (and others) are nonconservative for such small flaws. No significant indications were detected in the Pilgrim material by ultrasonic techniques. Unfortunately, the Pilgrim segments contained relatively little weldment; thus, we limited our ultrasonic examinations to the cladding and subcladding regions. Fluorescent liquid penetrant inspection of the cladding surfaces for both LWR segments detected no significant indications [i.e., for a total of approximately 6.8 m^2 (72 ft^2) of cladding surface].

14517 (EPRI-NP—3596-SR-Rev.1) PICEP: Pipe Crack Evaluation Program (Revision 1): Special report. Norris, D.M.; Chexal, B. (Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1987. 101p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920133/JAW.

This report describes software for calculating single- or two-phase flow through cracks in pipes and steam generator tubes. Op-

tions are available for calculating the crack-opening area and the critical (stable) crack length. The program is useful in performing leak-before-break analysis to demonstrate detectable leak rates prior to crack growth instability. Input to the code includes material properties, loads, thermal-hydraulic conditions, pipe geometry, and crack type and orientation. Theory and user information are provided in this report. 16 refs., 7 figs.

14518 **(EPRI-NP—5544) Nuclear unit operating experience: 1985-1986 update: Final report.** LeShay, D.W.; Koppe, R.H.; Olson, E.A.J. (Stoller (S.M.) Corp., Boulder, CO (USA)). Dec 1987. 356p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920135/JAW.

This report presents results of a project conducted by the S.M. Stoller Corporation for EPRI. The purpose of the project was to analyze the operational experience of nuclear units within the United States during the calendar years 1985 through 1986 using the Operating Plant Evaluation Code (OPEC-2) System and other available sources of operational data. The report updates and supplements previous EPRI reports NP-1191, NP-2092, NP-3480, and NP-4368. The overall performances of US nuclear units and the availability and capacity factor losses for the constituent systems and components are presented. The problem areas which have impacted most significantly on nuclear unit performance during 1985 to 1986 are discussed in detail. Forced outage rates and scram rates are also investigated. The 92 domestic nuclear units which were considered in this report inlcude all units which are rated 400 MW(e) or greater. Three Mile Island 2 was excluded from all analyses of this report. The performances of BWRs and PWRs in the United States during 1985 through 1986 were compared with similar units operating in foreign countries.

14519 **(EPRI-NP—5569) Chromate substitutes for corrosion inhibitors in cooling systems: Final report.** Brobst, G.E. (GEBCO Engineering, Edgewater, MD (USA)). Dec 1987. 36p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920144/JAW.

Chromate chemistry has historically been the corrosion inhibitor for use in nuclear plant component cooling water systems (CCWS). The potential, inadvertent release of chromates has led many utilities into a search for an adequate substitute corrosion inhibiting system for the CCWS. To be sure the inhibitor satisfies all necessary criteria, a qualification program for its use should be established. This report presents a qualification program for chromate-alternatives, including corrosion inhibiting effectiveness, compatibility with the environment, and compatibility with other plant systems. Several utilities have already replaced chromates as CCWS corrosion inhibitors. Available information on three of these alternatives has been extracted from technical literature and from use-experience, relative to the recommended qualification program. Summaries of this information is also included in this report.

14520 **(NUREG—1275-Vol.2) Operating experience feedback report: Air systems problems: Commercial power reactors.** Ornstein, H.L. (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Dec 1987. 127p. NTIS, PC A07/MF A01 - GPO. Order Number TI88900268/JAW.

This report highlights significant operating events involving observed or potential failures of safety-related systems in US plants that resulted from degraded or malfunctioning non-safety grade air systems. Based upon the evaluation of these events, the Office for Analysis and Evaluation of Operational Data (AEOD) concludes that the issue of air systems problems is an important one which requires additional NRC and industry attention. This report also provides AEOD's recomendations for corrective actions to deal with the issue.

14521 **(NUREG/CR—4667-Vol.3) Environmentally assisted cracking in light water reactors: Semiannual report, April-September 1986.** Shack, W.J.; Kassner, T.F.; Maiya, P.S.; Park, J.Y.; Ruther, W.E. (Argonne National Lab., IL (USA)). Sep 1987. Contract W-31109-ENG-38. 87p. (ANL—87-37). NTIS, PC A05/MF A01 - GPO. Order Number TI88003353/JAW.

This progress report summarizes work performed by Argonne National Laboratory on environmentally assisted cracking in light water reactors during the six months from April 1986 through September 1987. 56 refs., 36 figs., 13 tabs.

14522 **(NUREG/CR—4984) Development of a three-dimensional flux synthesis program and comparison with 3-D transport theory results.** Chowdhury, P.; Williams, M.L.; Kam, F.B.K. (Louisiana State Univ., Baton Rouge (USA). Nuclear Science Center; Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 101p. (ORNL/TM—10503). NTIS, PC A06/MF A01 - GPO. Order Number TI88004581/JAW.

A three-dimensional (3-D) flux synthesis program called DOTSYN has been developed for the Electric Power Research Institute (EPRI) to estimate neutron fluence in light water reactors (LWRs). The main purpose of developing this program is to provide the US utilities with an economical tool for routine 3-D fluence calculations at various ex-core locations in a reactor, especially at critical pressure vessel sites for embrittlement analysis. The synthesis is based on a simple expression which uses lower dimensional flux values obtained from 2-D and 1-D transport theory calculations to approximate the desired 3-D fluxes. In order to verify the accuracy and efficiency of the method, a simulated pressurized water reactor, similar in configuration to the Babcock & Wilcox Arkansas Nuclear One Unit 1 (ANO-1) reactor, is modeled in 3-D cylindrical coordinates, and calculations are performed with the Three-dimensional Oak Ridge Transport code TORT as well as with DOTSYN. Results by TORT are used as a reference 3-D "benchmark" solution, and DOTSYN results at various locations, especially near the preasure vessel, are compared to this reference solution. It has been concluded that the 3-D synthesis method is a very efficient method for estimating reactor preasure vessel fluence, which gives acceptable accuracy within the vessel even at axial locations far above the active core height.

14523 **Evaluation of the leakage potential of a personnel airlock subject to severe accident loads.** Clauss, D.B. (Sandia National Labs., Albuquerque, NM, USA). pp 147-152 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. J. Extreme loading and response of reactor containments. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—). Contract AC04-76DP00789.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Preliminary analysis and plans for testing a full-size personnel airlock under conditions representative of severe accident environments have been described. Leakage from personnel airlocks represents a potential failure mode of LWR containment buildings and thus, it must be considered in a systematic evaluation of containment performance. Test results will be used to validate the analytical and empirical models proposed for predicting leakage from personnel airlocks.

14524 **Plans and preparation for the destructive testing of a reinforced-concrete containment model.** Horschel, D.S.; Lambert, L.D. (Sandia National Labs., Albuquerque, NM, USA). pp 203-208 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. J. Extreme loading and response of reactor containments. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—). Contract AC04-76DP00789.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The objective of the containment model testing is to generate data that can be used to qualify methods for reliably predicting the response of LWR containments to over-pressurization. The latest effort of this series of experiments is the pressure testing of a 1:6-scale LWR containment model made of reinforced concrete, which will be tested to failure in early 1987. The instrumentation that will be used during the test as well as the plans for conducting the test are described.

14525 Design and construction of a large reinforced concrete containment model to be tested to failure. Ucciferro, J.J.; Horschel, D.S. (United Engineers and Constructors, Inc., Philadelphia, PA, USA; Sandia National Labs., Albuquerque, NM, USA). pp 209-214 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. J. Extreme loading and response of reactor containments. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—). Contract AC04-76DP00789.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The design and construction of the containment model are the subject of this paper.

14526 Analytical predictions for the performance of a reinforced concrete containment model subject to overpressurization. Weatherby, J.R.; Clauss, D.B. (Sandia National Labs., Albuquerque, NM, USA). pp 215-220 of Transactions of the 9th international conference on structural mechanics in reactor technology. Vol. J. Extreme loading and response of reactor containments. Wittmann, F.H. (ed.). Rotterdam, Netherlands; Balkema (1987). (CONF-870812—). Contract AC04-76DP00789.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

As part of the pretest analysis effort, Sandia has conducted a number of analyses of the containment structure using the ABAQUS general purpose finite element code. This paper describes results from a nonlinear axisymmetric shell analysis as well as the material models and failure criteria used in conjunction with the analysis.

14527 Development of a real-time stability measurement system for boiling water reactors. March-Leuba, J.; King, W.T. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **54**: 370-371(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

This paper describes the development of a portable, real time system for boiling water reactor (BWR) stability measurements. The system provides a means for the operator to monitor the reactor stability using existing plant instrumentation and commercially available hardware. The noise component (i.e., perturbations around steady state) of the neutron signal in BWRs has been shown to contain information about reactor stability, and several algorithms have been developed to extract that information. For the present work, the authors have used an algorithm that has been implemented on a portable personal computer. This algorithm uses the autocorrelation function of naturally occurring neutron noise (measured without special plant perturbations) and an autoregressive modeling technique to produce the asymptotic DR. For this real-time implementation, neutron noise data is preconditioned (i.e., filtered and amplified) and sampled at a 5-Hz sampling rate using a commercial data-acquisition system. Approximately every 1.5 min, the current (snapshot) autocorrelation function is computed directly from the data, and the average autocorrelation is updated. The current and average DR estimates are evaluated with the same periodicity and are displayed on the screen along with the autocorrelations and average power spectrum of the neutron noise.

14528 Correlation of Fukushima data with SSI models. Miller, C.A.; Costantino, C.J.; Philippacopoulos, A.J. (City Coll., New York, USA. Dept. of Civil Engineering; Brookhaven National Lab., Upton, NY, USA. Dept. of Nuclear Energy). pp 317-322 of Transactions of the 8th international conference on structural mechanics in reactor technology. Vol. K(a). Seismic response analysis of nuclear power plant systems. Stalpaert, J. (ed.). Amsterdam, Netherlands; North-Holland (1985). (EUR—10001-DE/EN/FR; CONF-850809—).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

The seismic response of nuclear power plant structures is often calculated using lumped parameter methods. A finite element model of the structure is coupled to the soil with a spring-dashpot system used to represent the interaction process. The parameters of the interaction model are based on analytic solutions to simple problems which are idealizations of the actual problem. The objective of this work is to compare predicted response using the standard lumped parameter models with experimental data. These comparisons are shown to be good for fairly uniform soil systems.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 14149, 14177, 14181, 14358, 14516, 14517, 14518, 14519, 14520, 14521, 14522, 14523, 14524, 14525, 14526, 14592, 14621, 14626, 14651, 14653, 14655, 14657, 14659, 14662, 14665, 14666, 14667, 14669, 14674, 14677, 14678, 14680, 14682, 14683, 14690, 14691, 14693, 14697, 14698, 14700, 14701, 14702, 14901, 15061, 15435, 16203

14529 (AEEW-M—2369) Use of CACTUS to generate modified diffusion coefficients in LWRWIMS. Halsall, M.J. (UKAEA Atomic Energy Establishment, Winfrith). Nov 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750955/JAW.

A new method has been devised in the lattice code, LWRWIMS, for modifying diffusion coefficients for poison pins. The method is based on an earlier one which used a one dimensional transport calculation of flux gradient and leakage to determine the effective diffusion coefficient. The improvement is to use a two dimensional characteristics transport calculation to overcome the approximations in geometry made previously. The report explains the theory of the method, describes its use within LWRWIMS, and gives some results obtained.

14530 (AEEW-R—1982) Fission product chemistry and aerosol behaviour in the primary circuit of a pressurised water reactor under severe accident conditions. Bowsher, B.R. (UKAEA Atomic Energy Establishment, Winfrith). Sep 1985. 77p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750886/JAW.

Three key accident sequences are considered covering a representative range of different environments of pressure, flow, temperature history and degree of zircaloy oxidation, and their principle thermal hydraulic and physical characteristics affecting chemistry behaviour are identified. Inventories, chemical forms and timing of fission product release are summarized together with the major sources of structural materials and their release characteristics. Chemistry of each main fission product species is reviewed from available experimental and/or theoretical data. Studies modelling primary circuit fission product behaviour are reviewed. Requirements for further study are assessed.

14531 (AEEW-R—2043) SEM/EDAX study of particulate material filtered from PWR primary coolant. Kingsbury, A.F.; Beare, S.P.; Amey, M.D.H. (UKAEA Atomic Energy Establishment, Winfrith). Jan 1986. 25p. (PWR-CWG-P—86-364). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750889/JAW.

Insoluble material filtered from primary circuits of the Doel and Loviisa PWRs has been characterised for size, shape, and composition using scanning electron microscopy and energy dispersive X-ray analysis. Based primarily on manual SEM/EDAX analysis, results from the automated Tracor analysis of more than 800 particles are presented. Autoradiography was used to identify the radioactive particles. Very few radioactive particles were identified amongst the majority of non-active particles. Results indicated that the particulate materials were of a very heterogeneous nature and differences in composition were also evident between the Westinghouse/Framatome and VVER PWRs.

14532 (AEEW-R—2093) Preliminary UKAEA reactor physics calculations on CYCLE 1 and part of CYCLE 2 of Zion Unit 2 PWR. Nash, G. (UKAEA Atomic Energy Establishment, Winfrith). Jun 1986. 182p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750917/JAW.

Calculations were made using the UKAEA reactor physics code package LWRWIMS/JOSHUA, to provide comparisons with similar calculations on the first two cycles of Sizewell B. In Zion cycle 1, the channel power distributions agree quite well with measurement, but there is less good agreement for low burnups in cycle 2. Core axial power profile calculations for cycle 1 also agree quite well with measurement, although the agreement is less good at intermediate cycle burnups. In cycle 2, these do not show the same trends as the measured axial offset. (U.K.).

14533 (CEA-N—2530) Representation of the deduction with tetravalent logic: realisation of fast inference motors. Terrier, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Electronique et d'Instrumentation Nucleaire). May 1987. 365p. (In French). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751727/JAW.

Building automats for surveillance, control or diagnosis, can be done by artificial intelligence. They function according to the formalism of O ordre propositional logic. Deduction modes can then easily be represented in a trivalent logic with both efficiency and concision. One can obtain workable codes with low storage of high speed (env. 5000 rules per second). This leads us to develop and entry langage with extremely simple statement rules which can be learnt by experts in practically no time. Finally in order to generalize this principle and draw rules with multi-choice conclusions, (if... then the motor stops or the pressure goes down), rewriting these processes enable to return to an equivalent system without multi-choice conclusions, providing the same amount of informations with the possibility of deciding. This study has been used on 2 different cases: first it served as a tool to analyse reliability, (OLAF), second to help diagnosis breakdown of pressurized water-reactors.

14534 (CLM-R—263) New heat transfer model for density stratified molten pools with internal heat sources. The TWOLAY code. Morgan, J. (UKAEA Culham Lab., Abingdon). Oct 1985. 32p. H.M. Stationery Office, London, price Pound 5.00.

This paper presents a new model (coded in the TWOLAY computer program) of heat transfer from internally heated molten pools which are density stratified into two layers. TWOLAY results are presented which cover the most probable range of conditions appropriate to postulated severe accidents in a large modern PWR. These calculations are compared with those of a corresponding single-layer model. Relative to single-layer models, the two-layer model produces significantly enhanced lateral heat fluxes just below the upper surface of the pool. For this reason it is concluded that any predictive model of in-vessel thermal attack should provide for stratified pool heat transfer. Although the model described here has been primarily developed for studies of in-vessel thermal attack it could, with suitable geometry modifications, be applied to other molten pool configurations. Although here applied to water reactor severe accident conditions, the model and code are also suitable for LMFBR applications.

14535 (EPRI-NP—4978-Vol.2) Evaluation of intergranular attack on Alloy 600: Volume 2, Effectiveness of boric acid: Final report. Hermer, R.E.; Wolfe, C.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Steam Generator Technology Div.). Dec 1987. 261p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920139/JAW.

The effect of boric acid applied on-line and via crevice flushing was evaluated in this program as a remedial action for intergranular attack on mill annealed Alloy 600 steam generator tubing in tubesheet and support plate crevices. Single tube model boilers were used to simulate the full length of a steam generator tubesheet crevice and the support plate crevices at hot leg conditions. The tubesheet crevices had preloaded inventories of 10% sodium hydroxide/2.5% sodium sulfate solution. All of the crevices were exposed to on-line additions of 0.1 ppM hydroxide and 0.04 ppM sulfate as the sodium salts. These baseline conditions caused pre-existing IGA beneath eccentrically mounted support plates to increase in depth at a rate of 2.40 μm/day. In the tubesheet crevices the pre-existing IGA increased in depth at a rate of 1.6 μm/day. The virgin mill annealed tubing in the tubesheet crevice developed IGA at a rate of 0.73 μm/day during the final 60 days of the 90 day test. The first 30 days were an incubation period during which no IGA occurred. The results of this work suggest that boric acid can inhibit IGA on unattacked tubing when applied continuously at the field specifiation of 5 to 10 ppM in the blowdown. It can also slow down propagation of pre-existing IGA if present in the proper ratio (which requires adequate treatment levels) and if it can access the corrosion sites. Corrosion may progress in areas where boric acid is not able to penetrate in sufficient excess to the corrodent present. 10 refs., 85 figs., 39 tabs.

14536 (EPRI-NP—5547) Tubesheet expansion improvements: Final report. Pement, F.W.; Economy, G.; Jacko, R.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Dec 1987. 158p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920115/JAW.

Specimens consisting of mill annealed Alloy 600 tubing expanded into steel collars were used to simulate steam generator tube sheet expansion transitions. The expansions were produced mechanically (by hard rolling), hydraulically or exposively. The specimens were exposed either internally pressurized or unpressurized in 750°F steam containing hydrogen or 680°F water containing dissolved hydrogen. Stress corrosion cracking (SCC) was observed only in as-expanded specimens, whether pressurized or unpressurized, exposed in the 750°F steam. The times required to develop SCC ranged from 209 to 763 hours for the pressurized specimens (throughwall SCC) and from 820 to 4000 hours for the unpressurized specimens (partwall SCC). Specimens that were peened or stress relieved did not develop SCC. Threshold stress studies with ID-stressed C-rings exposed for 2250 hours in the 750°F steam condition showed definitive SCC at 72 ksi, incipient SCC at 57 ksi, and no SCC at 45 ksi.

14537 (EPRI-NP—5558) Boric acid application guidelines for intergranular corrosion inhibition: Topical report. Hermer, R.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Service Technology Div.). Dec 1987. 157p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920134/JAW.

A significant fraction of the operating Pressurized Water Reactor steam generators have used or are using boric acid as an inhibitor to control stress corrosion cracking, intergranular attack, or denting. Boric acid is applied via crevice flushing, low power soaks, on-line, or using a combination of these methods. When boric acid is used it is important to have knowledge about its chemical and physical properties, its effect on corrosion, and how it should be correctly applied. The data on these subjects may be found in a diversity of sources, which are often not readily available or convenient to use. This document has been prepared to be a comprehensive treatise on boric acid relevant to its application in nuclear steam generators. 49 refs., 31 figs., 16 tabs.

14538 (INIS-mf—11032, pp 38-40) Possible applications of REVIS automated information system. Kandrac, J. 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780032/JAW.

In VUPEK Newsletter 1/86.

The REVIS information system comprises design, technology and economy data on nuclear power plants under construction, in operation and projected in all parts of the world. It contains data on individual units, on annual and monthly power generation and production indices, as well as on outages of the nuclear power plant. The structure of the data base will allow to store data on ca. 300 nuclear power plants over a period of 25 years of operation. (J.B.).

14539 (INIS-mf—11032) **VUPEK Newsletter 1/86.** (Vyzkumny Ustav Palivoenergetickeho Komplexu, Prague (Czechoslovakia)). 1986. vp. (In Slovak). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780032/JAW.

Separate abstracts were prepared for the individual papers in this report.

14540 (INIS-mf—11034, pp 8-18) **MORNAP program modelling of nuclear power plant operation.** Raninec, S. 1986. (In Slovak). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780033/JAW.

In VUPEK Newsletter 2/86.

A flow chart is given of the MORNAP program and the operation is described of its subprograms. The calculations which were made have proved the ability to model the operation of a nuclear power plant as a subsystem of the power transmission system and to make an analysis of the operation of a nuclear power plant with four units. The MORNAP program is a suitable mathematical tool especially for the technical and economic optimization of the operation of a nuclear power plant. (J.B.).

14541 (INIS-mf—11095, pp 68-98) **Materials problems of PWR type nuclear power plants.** Koutsky, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 9 Dec 1986. (In Czech). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88701081/JAW. (CONF-8610377—).

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

The requirements are discussed in detail on the materials for the main components of light water reactor power plants, and the properties of the materials. They include low-alloy steel 15Kh2MFA for pressure vessels of Novovoronezh type reactors. Austenitic steel 0Kh18N10T or 0Kh18N12T is used for the primary circuit piping, or alternatively, low-alloy ferritic steels are used which are protected from corrosion with an inner lining of austenitic steel of about 5 mm in thickness. The heat transfer tubes and steam generator collectors for WWER reactors are manufactured from austenitic stainless steel 08Kh18N10T. Briefly outlined are the problems of materials for fuel element cladding and for steam turbines. (Z.M.). 6 figs., 5 tabs., 9 refs.

14542 (INIS-mf—11095, pp 122-142) **Safety and reliability of nuclear power plants with PWR's.** Dusek, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 9 Dec 1986. (In Czech). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88701081/JAW. (CONF-8610377—).

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

The problems are discussed of safety and reliability of light water reactor power plants. The attitude of the public towards nuclear safety is briefly characterized. The individual safety categories of nuclear power plants are analyzed, i.e., safety in normal operation, in the event of an accident and in the event of external threat. Attention is paid to the basic concepts of nuclear safety, such as the three-barrier protection, the three-tier safety concept, the maximum design basis accident, and probability assessment of safety, as well as to the problems of input data. The IAEA initiatives are described in the field of nuclear safety, including the Nuclear Safety Standards Program and the Incident Reporting System. Nuclear safety in Czechoslovakia is briefly characterized, this from the aspects of legislature and of the inclusion of the area in the scientific and technical development tasks. (Z.M.). 10 refs.

14543 (INIS-mf—11096, pp 143-157) **WWER diagnostics.** Erben, O.; Horinek, K.; Houska, Z.; Rejchrt, J.; Rygl, J.; Stulik, P.; Vasa, I. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 9 Dec 1986. (In Czech). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780047/JAW. (CONF-8610377—).

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

Within the state research project "Development of Nuclear Power till the Year 2000", the Institute of Nuclear Research is involved in a task whose scope is the diagnostics of the condition of the reactor core, the in-core inspection system, the mechanical behavior of the reactor internals and of the primary circuit piping. The procedures and instruments are briefly described used for noise diagnostics as are expert systems with special regard to the application of these techniques in nuclear power plants. Currently, the studies are concentrated to modelling the effects diagnosed in the reactor and the primary coolant circuit and to creating conditions for the implementation of an expert system for the Dukovany nuclear power plant. (Z.M.). 15 refs.

14544 (INIS-mf—11096, pp 199-210) **Operation of Dukovany nuclear power plant feed water unit.** Vita, J.; Sotola, P. (Jaderna Elektrarna, Dukovany, Czechoslovakia). 9 Dec 1986. (In Czech). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780047/JAW. (CONF-8610377—).

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

The present statistics of the failure rate of unit 1 of the Dukovany nuclear power plant shows that the actuators of the feed water level controllers in the steam generators are the assemblies most susceptible to failures. They are not sufficiently rated to the high pressure at the delivery of the electric feeding pumps and thus to the high pressure at the control valve. Various operating modes of the controllers are analyzed in detail and designs are suggested of reliable operation of the feeding assembly. They consist in the replacement with other types of the existing control servomotors, in the reduction in pressure at the feeding pump delivery, in the replacement of the existing discontinuous feed water level controllers in the steam generators with continuous controllers of the MODIN series, and in other modifications of the feed assembly control system. (Z.M.).

14545 (INIS-mf—11096, pp 211-225) **Design concept comparison of nuclear power plants with 440 MW and 1000 MW units.** Kupert, K.; Muric, J.; Dolezal, A.; Janous, O. (Skoda, Prague, Czechoslovakia. Vystavba Elektraren; Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 9 Dec 1986. (In Czech). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780047/JAW. (CONF-8610377—).

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

The concepts are compared of nuclear power plants with WWER-440 and WWER-1000 reactors, this not only with a view to the basic parameters, which are tabulated, but also to the designs of the two types of reactor. The WWER-440 reactor features six cooling loops, each consisting of a main circulating pipe of 500 mm in diameter, a main circulating pump, a main closing valve and a steam generator. Six steam generators produce steam for two turbines, each of an output of 220 MW. The WWER-1000 reactor has four cooling loops. Each consists of a pipe of 850 mm in diameter, a main circulating pump and a steam generator. No main closing valves are used. Four steam generators supply steam for one 1,010 MW turbine. As for design, attention is paid to the pressure vessels, reactor internals, fuel assemblies, control rod drives and main circulating pipes of both types of reactor. (Z.M.). 2 figs., 1 tab.

14546 (ITEF—4-1986) **Optimization of specific energy in power reactors.** Zaritskaya, T.S.; Kiselev, G.V.; Rudik, A.P.; Tsenter, Eh.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700886/JAW.

Optimal modes of RBMK and WWER-440 reactor critically maintanance, when maximum specific energy release being reached, are determined. The mode of nuclear fuel makeup with constant maximum permissible rate is shown to be the optimal mode of critically maintanance. 5 refs.; 3 figs.; 4 tabs.

14547 (ITEF—57-1986) Specific energy released in power reactors. Zaritskaya, T.S.; Kiselev, G.V.; Rudik, A.P.; Tsenter, Eh.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700679/JAW.

Technique of determination are described and analysis of specific energy for different methods of critically maintance of RBMK and WWER-440 reactors are conducted. Characteristics of the optimal mode of critically maintanance are determined. 12 refs.; 6 tabs.

14548 (IWGFPT—26, pp 77-87) Out of pile physical properties and in pile thermal conductivity of (U, Gd)O_2. Chotard, A.; Melin, P.; Bruet, M.; Francois, B. (Framatome, Lyon, France; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France). May 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87900925/JAW. (CONF-861045—).

From IAEA technical committee meeting on the safe handling of tritium; Vienna, Austria (13 Oct 1986).

The following physical properties of (U, Gd)O_2: lattice parameter; thermal expansion (from 300 K to 2000 K); melting point; specific heat (from 300 K to 1000 K); thermal conductivity (from 400 K to 1300 K); thermal diffusivity (from 300 K to 2100 K) have been studied out of pile for Gd_2O_3 contents up to 12 weight per cent. The study of the thermal conductivity has been completed with in pile measurements for Gd_2O_3 contents of 5 and 8 weight per cent. Except for thermal conductivity and lattice parameter which depend on gadolinia content, the results obtained are close to UO_2 values. In particular, out of pile values for thermal expansion are equivalent to those obtained for pure UO_2 whatever the Gd_2O_3 content may be, in the studied range. Also in this range, the solidus and liquidus are very close and no significant difference has been found between UO_2 and (U, Gd)O_2 melting point. The specific heat has been found nearly identical to pure UO_2 values. Measurements of thermal conductivity by radial heat flow and thermal diffusivity by the Flash Laser method have allowed to confirm the decrease of these properties with gadolinia content, which has been further confirmed by in pile measurements. These results are discussed and compared to the published data. 9 references, 5 figures, 2 tables.

14549 (JAERI-M—87-149) Two-dimensional, one-group neutron diffusion calculation program based on analytic solutions: SICO2D. Itagaki, Masafumi. (Japan Atomic Energy Research Inst., Tokyo). Sep 1987. 33p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751982/JAW.

A two-dimensional, one-group neutron diffusion program SICO2D has been developed for the purpose of efficient core simulations by means of an on-site minicomputer. This program is based on analytic solutions of the one-group diffusion equation. The XY-plane is divided into rectangular nodes, and integrating the two-dimensional (2-D) diffusion equation over a node results in two (X- and Y-directional) 1-D equations. Each 1-D equation is solved analytically and a type of shooting method is used in determining the critical eigenvalue and the corresponding flux distribution. The 2-D flux distribution is calculated using a nodewise buckling iteration. Results obtained in some test calculations for the IAEA 2-D PWR benchmark problem indicate that this program, as a consequence of the analytic flux representation, can achieve a significant reduction in computing time and required computer memory in comparison with the conventional fine-mesh program CITATION.

14550 (ND-R—1309(R)) Acoustic emission measurements of PWR weld material with inserted defects using advanced instrumentation. Bentley, P.G.; Beesley, M.J. (UKAEA Risley Nuclear Power Development Establishment). Oct 1986. 38p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750970/JAW.

Twenty-one steel tensile specimens containing realistic welding defects have been monitored for acoustic emission during loading to failure. A new design of broad frequency bandwidth point contact transducer was used and the resulting signal captured using a high speed transient recording system. The data was analysed using the techniques of statistical pattern recognition to separate different types of signals. The results show that it is possible to separate true acoustic emission from background noise and to distinguish between certain types of defect.

14551 (OP-LG—1881) Closing submission, Sizewell 'B' public inquiry. (Wansbeck District Council (UK)). Jan 1985. 97p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Wansbeck District is in S.E. Northumberland and includes Druridge Bay in its area. If permission to build a PWR at Sizewell-B is given, a further programme of PWR reactor building is expected. The CEGB has identified Druridge Bay as a possible site. The Wansbeck D.Cs. position is that it would wish the Sizewell-B inquiry inspector to recommend that consent for the construction of a PWR station at Sizewell-B should not be granted and that any programme of further PWR construction should not be proceeded with. Its closing submission covers need, economics and safety (including emergency planning arrangements). (U.K.).

14552 (ORNL/CSD/TM—244) Reactivity and isotopic composition of spent PWR [pressurized-water-reactor] fuel as a function of initial enrichment, burnup, and cooling time. Cerne, S.P.; Hermann, O.W.; Westfall, R.M. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88003658/JAW.

This study presents the reactivity loss of spent PWR fuel due to burnup in terms of the infinite lattice multiplications factor, k/sub ∞/. Calculations were performed using the SAS2 and CSAS1 control modules of the SCALE system. The k/sub ∞/ values calculated for all combinations of six enrichments, seven burnups, and five cooling times. The results are presented as a primary function of enrichment in both tabular and graphic form. An equation has been developed to estimate the tabulated values of k/sub ∞/'s by specifying enrichment, cooling time, and burnup. Atom densities for fresh fuel, and spent fuel at cooling times of 2, 10, and 20 years are included. 13 refs., 8 figs., 8 tabs.

14553 (SAAS—347) Calculation of passive neutron emission from spent WWER-440 fuel. Moeller, W.; Burmester, M. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1987. 143p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700939/JAW.

A major task of international nuclear material control consists in routinely determining the characteristics of spent nuclear fuel, such as burnup or plutonium content, by non-destructive methods. Among these, passive neutron assay takes a prominent position. As prerequisite for the proper interpretation of respective neutron measurement data, computations have been conducted to determine burnup, actinide content and neutron emission rates of WWER-440 fuel assemblies for a large number of operational conditions. The results were given in the form of graphs and tables.

14554 (EPRI-NP—4574-CCM-Pt.2-Ch.13-Vol.1) ARMP-02 documentation: Part 2, Chapter 13: NORGE-P computer code manual: Volume 1, Theory and numerics manual: Computer code manual. Borland, R.S.; Cobb, W.R.; Darnell, B.L.; Rothleder, B.M.; Singer, B.S. (Science Applications International Corp., Marietta, GA (USA)). Dec 1987. 45p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920117/JAW.

The NORGE-P code processes the output of the assembly analysis codes, EPRI-CPM, CASMO-1E or PDQ7-E, into input for the nodal codes, SIMULATE-E or NODE-P2, for the purpose of Pressurized Water Reactor Analysis. It also provides the kinetics data for the SIMTRAN code for subsequent linkage into RETRAN and a file of cross sections and kinetics data for use by NTPREP and ARROTTA. 13 refs., 7 tabs.

14555 (EPRI-NP—4574-CCM-Pt.2-Ch.13-Vol.2) ARMP-02 documentation: Part 2, Chapter 13: NORGE-P computer code manual: Volume 2, User's manual. Borland, R.S.; Cobb, W.R.; Darnell, B.L.; Rothleder, B.M.; Singer, B.S. (Science Applications International Corp., Marietta, GA (USA)). Dec 1987. 117p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920118/JAW.

The NORGE-P code processes the output of the assembly analysis codes, EPRI-CPM, CASMO-1E or PDQ7-E, into input for the nodal codes, SIMULATE-E or NODE-P2, for the purpose of Pressurized Water Reactor Analysis. It also provides the kinetics data for the SIMTRAN code for subsequent linkage into RETRAN and a file of cross sections and kinetics data for use by NTPREP and ARROTTA. 13 refs., 10 figs., 13 tabs.

14556 (EPRI-NP—4574-CCM-Pt.2-Ch.13-Vol.3) ARMP-02 documentation: Part 2, Chapter 13: NORGE-P computer code manual: Volume 3, Programmer's manual. Cobb, W.R.; Darnell, B.L. (Science Applications International Corp., Marietta, GA (USA)). Dec 1987. 98p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920119/JAW.

NORGE-P is a computer code which provides linkage between the assembly lattice physics codes EPRI-CPM, CASMO-1E and PDQ7-E and the nodal simulation codes SIMULATE-E and NODE-P2 for the purpose of Pressurized Water Reactor analysis. NORGE-P produces card image files for one-temperature and three-temperature nodal models. These cards contain tabulated cross-sectional data (for SIMULATE-E) and/or reactivity polynomials (for NODE-P2) as functions of several operational parameters. The important parameters include exposure, moderator densities, soluble boron and power (Doppler). NORGE-P is run for each assembly fuel type in the nodal model. NORGE-P also generates card images containing kinetics data for the SIMTRAN-E computer code which links these same assembly lattice physics codes to the RETRAN code. A file for the NTPREP program is also created for use with the NTPREP/NODETRAN/RETRAN linkage or with the ARROTTA code. NORGE-P is written entirely in FORTRAN. 13 refs., 8 figs., 5 tabs.

14557 LEPRICON analysis of pressure vessel surveillance dosimetry inserted into H.B. Robinson-2 during cycle 9. Maeker, R.E. (Oak Ridge National Lab., Oak Ridge, TN 37831). *Nuclear Science and Engineering;* 96: No. 4, 263-289(Aug 1987). Contract AC05-84OR21400.

A second example of applying the LEPRICON methodology to an existing pressurized water reactor is described. The present application is an analysis of ad hoc dosimetry inserted into the H.B. Robinson-2 reactor to monitor the effects on pressure vessel fluence produced by the introduction of a low-leakage fuel management scheme during cycle 9. The use of the simultaneous dosimetry at both a downcomer location and in the reactor cavity allowed a quantitative evaluation to be made by the LEPRICON procedure of the relative merits of each location. Unfolded results using the dosimetry indicate that the cumulative neutron fluence above 1 MeV originally calculated for the critical lower circumferential weld of the pressure vessel during cycle 9, 7.2 x 10/sup 17/ n/cm/sup 2/ +- 15.9%, should be adjusted upward by about one standard deviation to a value of 8.8 x 10/sup 17/ n/cm/sup 2/ with a reduced uncertainty of 10.9%.

14558 Investigation of failed tubes from 'B' steam generator of the R.E. Ginna nuclear power plant. Czajkowski, C.J. (Brookhaven National Lab., Upton, NY, USA). *International Journal of Pressure Vessels and Piping;* 29: No. 4, 275-289(1987).

An investigation was performed on various steam generator tubes from the R.E. Ginna nuclear power plant (Rochester Gas and Electric). These tubes were involved in the loss of coolant accident of January 1982. The report concludes that the loss of coolant accident was the result of a purely mechanical mechanism caused by an adjacent severed tube rubbing the outer surface of tube R42-C55 until its cross-section was insufficient to withstand the primary to secondary side pressure differential. The initial severing of the adjacent tubes is considered to have been caused by the impacting of one or more carbon steel foreign objects on the outer periphery tubes in the 'B' steam generator.

14559 Influence of the local site condition on seismic response of a PWR-reactor building. Chen, J.C.; Johnson, J.J. (Lawrence Livermore National Lab., CA, USA; Structural Mechanics Associates, San Ramon, CA, USA). pp 243-248 of Transactions of the 8th international conference on structural mechanics in reactor technology. Vol. K(a). Seismic response analysis of nuclear power plant systems. Stalpaert, J. (ed.). Amsterdam, Netherlands; North-Holland (1985). (EUR—10001-DE/EN/FR; CONF-850809—).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

The influence of local site conditions on soil-structure interaction (SSI) response of a PWR containment building founded on 11 different sites was investigated using substructure SSI analysis procedures. The structures analyzed for both surface and embedded foundation conditions for each site except one half-space site with shear wave velocity 5000 fps. A total of 23 analysis scenarios are presented. Responses (peak accelerations and response spectra) at selected locations in the structure were compared. The results indicate that the local site conditions have a significant influence on SSI responses.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 14546, 14547, 14627, 14632, 14652, 14654, 14663, 14664, 14671, 14672, 14673, 14676, 14693, 14694, 14704, 14985, 16203, 16220

14560 (CEGB-TPRD/B—0850/R86) Methods of assessing the effects of interface oxide growth in Magnox and AGR plant. . McLauchlin, I.R.; Wootton, M.R.; Morgan, J.D.; Watson, L.H. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Sep 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750959/JAW.

Growth of oxide at interfaces between structural steel components in CO_2 cooled reactors can deform fastenings such as bolts and welds. The mechanical response of joint members to oxide growth is discussed, and methods of assessment are outlined which contribute to procedures for ensuring continued structural integrity.

14561 (INIS-GB—104) Report of NII investigation into allegations of faulty welding at Hinkley 'B' nuclear power station. (Health and Safety Executive, Bootle (UK). Nuclear Installations Inspectorate). 15 Jul 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751261/JAW.

This reports the procedure and findings of the Nuclear Installations Inspectorate's investigation into allegations of welding and radiography malpractice at Hinkley Point-B power station. These concerned welds and their radiographic testing made on pipework carrying water or steam associated with one of the main electricity turbo generators, during construction in 1971. The water or steam is not radioactive and pipe failure would have no nuclear safety significance. Both the Central Electricity Generating Board and the NII investigated the allegations. Both investigations concluded that there was no evidence to support the allegations. (U.K.).

14562 (INIS-GB—105) Report of the NII investigation into allegations concerning quality control during the construction of Heysham 2 power station. (Health and Safety Executive, Bootle (UK). Nuclear Installations Inspectorate). 4 Aug 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751262/JAW.

The Nuclear Installations Inspectorate have investigated allegations of poor quality control in the manufacture and installation of pipework carrying cooling water for the reactor vessel and various auxiliary systems and gas, mainly carbon dioxide, for treatment. After considerable investigation of each allegation it was concluded that none provided a cause for concern over the safety standards at Heysham-2 reactor. (U.K.).

14583 (JAERI-M—87-160) Development of thermal hydraulic analysis code for high temperature gas-cooled reactor core (TEMPEST). Suzuki, Kunihiko. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 81p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751988/JAW.

In the development of HTGR, it is one of the major purposes to get higher temperature of reactor outlet gas. For that purpose, not only research and development of fuel element which is superior in high temperature characteristics, but also appropriate core design is necessary, which can produce higher temperature of reactor outlet gas without failure of fuel under the same reactor power. Therefore, a steady state core thermal hydraulic analysis code, TEMPEST for the high temperature-gas cooled reactor core was developed, which calculates the coolant flow and fuel temperature distributions in the core and analyzes fuel kernel migration and SiC layer attack by Pd in coated particle fuels, which are important factors to evaluate the integrity of High Temperature Gas-Cooled Reactor fuel. The "TEMPEST" code represents the whole core by the multi-channel model and can deal with a set of channel assigned to flow control regions. In each channel, one-dimensional steady state heat conduction equation is applied in consideration of the dimensional changes of fuel rods caused by thermal expansion and irradiation of fast neutron. The "TEMPEST" code itself has the data of heat transfer coefficient, friction factor, and material properties such as thermal conductivities of fuel compact and graphite sleeve, and equations for the evaluation fuel integrity. Among these data, data for fuel element of High Temperature Test Reactor (HTTR) which Japan Atomic Energy Institute (JAERI) has been engaged in research and development for are evaluated conservatively based on the experimental data obtained in JAERI, and useable for HHTR core design. The present report describes the analytical model, analytical methods and the program structure of the code.

14584 (UCRL—95047-Rev.2) Gas-cooled reactor power systems for space. Walter, C.E. (Lawrence Livermore National Lab., CA (USA)). Jan 1987. Contract W-7405-ENG-48. 32p. (CONF-870102—1-Rev.2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005220/JAW.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Efficiency and mass characteristics for four gas-cooled reactor power system configurations in the 2- to 20-MWe power range are modeled. The configurations use direct and indirect Brayton cycles with and without regeneration in the power conversion loop. The prismatic ceramic core of the reactor consists of several thousand pencil-shaped tubes made from a homogeneous mixture of moderator and fuel. The heat rejection system is found to be the major contributor to system mass, particularly at high power levels. A direct, regenerated Brayton cycle with helium working fluid permits high efficiency and low specific mass for a 10-MWe system.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 14645

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 14621, 14650, 14693, 14703

14585 (ANL-FRA—161) The performance of 3500 MWth homogeneous and heterogeneous metal fueled core designs. Turski, R.; Yang, Shi-tien. (Argonne National Lab., IL (USA)). Nov 1987. Contract W-31109-ENG-38. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003678/JAW.

Performance parameters are calculated for a representative 3500 MWth homogeneous and a heterogeneous metal fueled reactor design. The equilibrium cycle neutronic characteristics, safety coefficients, control system requirements, and control rod worths are evaluated. The thermal-hydraulic characteristics for both configurations are also compared. The heavy metal fuel loading requirements and neutronic performance characteristics are also evaluated for the uranium startup option. 14 refs., 14 figs., 20 tabs.

14586 (CEA-CONF—9038) TRIPOLI-2 studies of the JASON experiment (Streaming effect) comparison with experiment and other codes. Vergnaud, T.; Nimal, J.C.; Calamand, D.; Salvatores, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Apr 1987. 16p. (CONF-870424—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751346/JAW.

From American Nuclear Society international meeting on advances in reactor physics, mathematics and computation; Paris, France (27 Apr 1987).

TRIPOLI-2 system uses the Monte Carlo method to calculate neutron transport in the JASON experiment which allows to study neutron deep penetration in sodium and to simulate neutron streaming between the containment tanks of a LMFBR. Several detector responses have been calculated and results are compared with measurements and other code results. 11 figs.

14587 (CEGB-TPRD/B—0814/R86) Life limiting features and technical problems to reach high burn-up in fast reactor fuel. Cecchi, P.F.; Millet, P.; Pay, A.; Toebbe, H.; Jones, R.B.; Norris, D.I.R. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jun 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750867/JAW.

A broad overview is given of the known and postulated mechanisms which may limit the in-core life of sodium cooled mixed oxide fuel pins clad in cold worked stainless steels or in other austenitic or ferritic alloys. Failure mechanisms and other life-limiting factors are broadly classified as being due to the effects of irradiation damage dose, fuel burn-up and in-reactor residence time. The inter-relation between these factors changes with progress from a small test reactor to a prototype to a large modern reactor. Detailed discussion is given of the limits to fuel life imposed by dimensional changes, by the possibility of rupture due to fission gas pressure or to fuel-clad mechanical interaction and by corrosion of the clad internally and externally. Despite these life-limiting features, there has been steady progress towards increasing the burn-up achieved with the materials of current usage by a combination of adequate design and optimisation of their potential. The development of improved alloys is proceeding but achievement with them of a target of 20% maximum burn-up with commercial standards of reliability will require careful optimisation of materials, designs and operating conditions.

14588 (CLM-R—267) Rate limited MFCI model for sodium. Part II: model improvements and Hicks-Menzies calculations. Fletcher, D.F. (UKAEA Culham Lab., Abingdon). May 1986. 28p. H.M. Stationery Office, London, price Pound 4.00.

Part I: CLM-R-262.

The author describes modifications to CURLIM, a rate limited molten fuel-coolant interaction [MFCI] model for sodium. The modifications include improvements to the heat transfer model and the incorporation of a model of heat loss from the interaction zone. In addition, the treatment of returning rarefaction waves during the acoustic loading state is modified. Finally, CURLIM is used to perform Hicks-Menzies calculations using the latest equation of state for sodium.

14589 (INIS-GB—103) Dounreay [Nuclear Power Development Establishment]. (UKAEA Dounreay Nuclear Power Development Establishment). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750345/JAW.

The story of the Fast Reactor and Dounreay is told. The way the PFR reactor works, the fuel it uses, the safety aspects of the PFR reactor design and the economics, are all explained simply. The PFR reprocessing plant is also explained. The research work done at Dounreay, the management of the radioactive wastes produced and the environmental effects and monitoring are also mentioned. (U.K.).

14570 **(ND-R—1265D) Re-examination of early sodium-water reaction experiments in the context of design basis accidents.** Anderson, R.; Edge, D.M.; Bell, A.C. (UKAEA Risley Nuclear Power Development Establishment). Feb 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750871/JAW.

Complete tube failure in an LMFBR Steam Generator Unit would allow the injection of high pressure steam into the liquid metal. Events which might lead to such an occurrence need to be understood to provide a Design Basis. Early UK tests suggested that secondary steam tube failure could occur very shortly (2 or 3 seconds) after the initiating event and therefore several tube failures within several seconds was chosen as the Design Basis Accident. Since then many more tests have been carried out world-wide, all of which confirm that secondary failures do not occur after a Large Leak. During Intermediate Leaks and Small Leaks secondary failures only occur after relatively long intervals (> 10 s). This has led to the concensus that the Design Basis Accident should be a single complete tube failure. To confirm the validity of this assumption, this paper re-examines the early UK tests and shows that they relate to untypical conditions and therefore should not be used in the definition of Design Basis Accidents.

14571 **(WAPD-TM—1551) Defueling of the Light Water Breeder Reactor at the Shippingport Atomic Power Station (LWBR Development Program).** Selsley, I.A. (ed.). (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Sep 1987. Contract AC11-76PN00014. 214p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88005239/JAW.

The Light Water Breeder Reactor (LWBR) core was defueled after successfully operating for 29,047 effective full power hours (EFPH). This report describes operations performed to remove fuel from the reactor, the tools required to perform these operations, and the components that were removed. Defueling of LWBR was a joint effort by personnel from Westinghouse Electric Corporation's Bettis Atomic Power Laboratory and Duquesne Light Company, which had prime responsibility for operations at Shippingport.

14572 **(WAPD-TM—1552) Light Water Breeder Reactor fuel module disassembly at the Shippingport Atomic Power Station (LWBR Development Program).** Selsley, I.A. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1987. Contract AC11-76PN00014. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005316/JAW.

After successfully operating for 29,047 effective full power hours, the Light Water Breeder Reactor (LWBR) core was defueled prior to total decommissioning of the Shippingport Atomic Power Station. All nuclear fuel and much of the reactor internal hardware was removed from the reactor vessel and prepared for shipment to disposal sites or to the Naval Reactors Expended Core Facility in Idaho for examination, further disassembly, and final disposal. Fuel modules were partially disassembled at Shippingport. Seed module support shafts, reflector module seal blocks, and blanket module support tubes, seal blocks, and guide tube extensions were removed. This partial disassembly was required to enable the fuel modules to fit in M-130 shipping containers. No significant problems occurred during disassembly operations. Radiation and personnel exposure levels were carefully controlled.

14573 **(WAPD-TM—1553) Shipment of the Light Water Breeder Reactor fuel assemblies from the Shippingport Atomic Power Station to the extended core facility (Idaho) (LWBR Development Program).** Selsley, I.A. (Bettis Atomic Power Lab., Pittsburgh, PA (USA)). Oct 1987. Contract AC11-76PN00014. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005315/JAW.

After successfully operating for 29,047 effective full power hours, the Light Water Breeder Reactor (LWBR) core was defueled prior to total decommissioning of the Shippingport Atomic Power Station. All nuclear fuel and much of the reactor internal hardware was removed from the reactor vessel and prepared for shipment to disposal sites or to the Naval Reactors Expended Core Facility in Idaho for testing or further disassembly. Three M-130 shipping containers were modified to accept LWBR seed, blanket, and reflector fuel modules for rail shipment to the Expended Core Facility. Thirty-nine LWBR fuel modules were transferred in 10 shipments. All shipments were completed successfully, without significant problems. Radiation and personnel exposure levels were carefully controlled.

14574 **(WAPD-TM—1602) Light Water Breeder end-of-life component examinations at Shippingport Atomic Power Station and module visual and dimensional examinations at Expended Core Facility (LWBR Development Program).** Wargo, J.E. (ed.). (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1987. Contract AC11-76PN00014. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88004729/JAW.

This report presents highlights of visual and dimensional examinations of the Light Water Breeder Reactor fuel assemblies and selected core components following five years of power operation in which the core achieved 29,047 effective full power hours. Each type of fuel assembly (seed, blanket, and reflector) is described, and the end-of-life conditions are documented in photographs and data plots. Fuel modules were examined immediately after removal from the reactor vessel at the Shippingport Atomic Power Station and after shipment to the Expended Core Facility at the Naval Reactors Facility in Idaho. Further inspection was performed on one seed and one reflector assembly after their external support shells were removed. Module length changes and bow data are presented for selected assemblies. Structural component examinations include magnetic particle testing and ultrasonic test inspection of the LWBR reactor vessel closure head. Visual inspections were also performed on compression sleeves and guide tube extensions which formed part of the guide path for the movable fuel assemblies. 4 refs., 103 figs., 5 tabs.

14575 **(WAPD-TM—1611) Light Water Breeder Reactor core evaluation operations at the expended core facility (LWBR Development Program).** Williams, J.T. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1987. Contract AC11-76PN00014. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005109/JAW.

This report presents an overview of the processes and equipment used to receive, examine, and store the Light Water Breeder Reactor (LWBR) fuel modules once they had been partially disassembled and shipped to the Expended Core Facility (ECF) in Idaho for storage in an underwater facility. At ECF, the 39 fuel modules underwent further disassembly to provide fuel rods for nondestructive testing to establish the core's breeding efficiency and to provide core components for examinations to assess their performance characteristics. Thirteen of the modules were examined visually with underwater cameras. Ten of the 13 plus two additional modules were disassembled to permit removal of individual fuel rods. A total of 1075 rods were removed from these 12 modules; 524 were examined at ECF, 34 were examined at Argonne National Laboratories (ANL), and the remainder of the rods were removed to allow internal examination of the modules. Additionally, a number of component pieces and fasteners were removed from the modules and examined. At the conclusion of the program, all modules and rods were shipped to the Idaho Chemical Processing Plant (ICPP) for long-term underground storage.

14576 **(WAPD-TM—1612) Proof of breeding in the Light Water Breeder Reactor (LWBR Development Program).** Schick, W.C. Jr.; Beaudoin, B.R.; Beggs, W.J.; Freeman, L.B.; Tessler, G. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Sep 1987. Contract AC11-76PN00014. 189p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88005093/JAW.

The Light Water Breeder Reactor (LWBR) was developed to demonstrate practical breeding while producing electrical energy in a commercial pressurized water reactor generating station. After the ^{233}U-thorium fueled core operated successfully for five years, expended fuel from the core was assayed to prove breeding - that is, production of more fissile fuel from thorium than was expended to produce energy. This demonstrates the existence of a vast source of electrical energy potentially capable of supplying the entire national need for many centuries using potential domestic thorium. The LWBR operated for more than 29,000 effective full power

hours in the Shippingport Atomic Power Station and contained more fissile fuel at the end of its five-year operational lifetime than at the beginning. Five hundred twenty-four fuel rods were randomly selected from the spent core for nondestructive assay to determine their final fissile fuel content. Two different nondestructive assay measurements were performed on each rod. Seventeen of these rods were subsequently assayed destructively to validate the nondestructive results. Two estimation methods, which agreed closely, were used to determine the fissile fuel content of the spent core. The more accurate method gave a value of 507.98 kg for the end-of-life fuel content of the core, with a total standard deviation of 0.14%. The fuel content of the beginning-of-life core was determined during core manufacture to be 501.02 kg, with a standard deviation of less than 0.04%. The increase in fissile fuel during core life was 1.39% +- 0.14%, in close agreement with prediction, thus demonstrating breeding in LWBR.

14577 **(WAPD-TM—1622) The Light Water Breeder Reactor neutron noise monitoring program (LWBR Development Program).** Schick, W.C. Jr. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Sep 1987. Contract AC11-76PN00014. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005233/JAW.

A program of neutron noise monitoring was in effect throughout the five-year lifetime of the Light Water Breeder Reactor (LWBR) at Shippingport, Pa. Initial neutron noise measurements were made at five different core power levels during station startup in August and September, 1977. Subsequent measurements were made on ten occasions through September, 1982, shortly before final shutdown. Noise spectra were obtained from four neutron detectors which were part of the nuclear instrument system and from two other detectors which were used solely for testing purposes. Power spectral densities were obtained for all detectors, and phase and coherence measurements were performed on various pairs of detector signals. The spectra confirmed the vibrational stability of the core barrel and thermal shield throughout the 5-year operational period. The noise level was within allowable limits at all times, and there was very little change in the signature over core lifetime. The measurements demonstrated that the core operated without significant vibration of internals or any other abnormal condition that could be detected by the method of neutron noise analysis.

14578 **Nuclear breeder reactor fuel element with silicon carbide getter.** Christiansen, D.W.; Karnesky, R.A. (to Dept. of Energy, Washington, DC). US Patent 4,710,343. 1 Dec 1987. Filed date 27 Nov 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A breeder reactor fuel element is described including a tubular cladding hermetically sealed at each end by an end plug, one interior portion of the cladding defining a fuel space filled with a column of fissile material comprising a mixture of PO/sub 2/ and UO/sub 2/, and an upper and lower fertile material blanket. The blanket comprises UO/sub 2/ arranged axially in tandem with the fissile column within the cladding. The improvement comprises a cesium getter disposed at least at the upper end of the upper blanket. The getter includes a helical rolled substrate of stainless steel coated with silicon carbide material for collecting and isolating cesium migrating thereto and the stainless steel substrate having dimples formed therein for holding apart successive convolutions of the rolled substrate to permit a volume expansion of the getter.

14579 **Calculation of temperature coefficients of reactivity for EBR-II kinetic analyses.** Meneghetti, D.; Kucera, D.A. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **54**: 376-377(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Temperature coefficients of reactivity for use in coupled neutronics-thermohydraulics kinetics codes, as for example the EROS code used for Experimental Breeder Reactor-II (EBR-II) kinetic analyses are both loading and problem-modeling sensitive. To enable appropriate temperature coefficients to be calculated for differing loading configurations and differing subassembly groupings in the kinetics analyses, an addition (TEMCO) has been made to the EBRPOCO code. EBRPOCO calculates detailed axially delineated contributions of the linear and Doppler components of the power-reactivity-decrement (PRD) for every subassembly and control rod location in an EBR-II configuration.

14580 **Feedback-reactivity time-dependencies for a negative reactivity insertion in EBR-II.** Grimm, K.N.; Meneghetti, D. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **54**: 379-380(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Knowledge of time-dependencies (and magnitudes) of feedback components is necessary for interpretation and understanding of transient behaviors. Described herein is one analysis of negative insertion (~ 36 cents) of a control rod from full power during Experimental Breeder Reactor-II (EBR-II) run 93a. The time-dependencies of the component feedbacks have been analyzed using 24 channels in the EROS computer code. Seventy distinct temperature coefficients of reactivity were used in conjunction with this 24-channel EBR-II model. These temperature coefficients of reactivity were obtained using an addition (TEMCO) to the EBRPOCO code.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 14695

14581 **(AD-A—185566/7/XAB) Shielding analysis of a small compact space nuclear reactor. Final report.** Woodrow, L.L. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Aug 1987. 214p. (AFWL-TR—87-94). NTIS, PC A10/MF A01.

The SP-100 reactor concept, currently in its developmental stage, has layered tungsten - lithium hydride shield. Studies indicate that this shield configuration is the lightest weight shield. This configuration and three other shielding concepts were analyzed to determine the lightest shield and to determine the shield configuration with the smallest volume. The other three concepts were a boron carbide - beryllium layered shield, and a lithium hydride - beryllium shield. FEMP2D and FEMP1D codes were used in this analysis. These codes were developed at Sandia National Laboratory (SNL), using the input from another code, RFCC, which produced energy-dependent dose conversion factors, and determined the shield's ability to attenuate the neutron and gamma radiation to permissible dose limits. The results of this analysis show that the lithium hydride - tungsten layered shield was indeed the lightest weight shield. However, a boron carbide - tungsten shield was calculably volume constrained. Therefore volume, not weight, may be the driving factor in determining the shield configuration.

14582 **(N—88-13209) Small reactor power systems for manned planetary surface bases.** Bloomfield, H.S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Dec 1987. 15p. (NASA-TM—100223; E—3839; NAS—1.15:100223). NTIS, PC A03/MF A01.

A preliminary feasibility study of the potential application of small nuclear reactor space power systems to manned planetary surface base missions was conducted. The purpose of the study was to identify and assess the technology, performance, and safety issues associated with integration of reactor power systems with an evolutionary manned planetary surface exploration scenario. The requirements and characteristics of a variety of human-rated modular reactor power system configurations selected for a range of power levels from 25 kWe to hundreds of kilowatts is described. Trade-off analyses for reactor power systems utilizing both man-made and indigenous shielding materials are provided to examine performance, installation and operational safety feasibility issues. The results of this study have confirmed the preliminary feasibility of a wide variety of small reactor power plant configurations for growth oriented manned planetary surface exploration missions. The capability for power level growth with increasing manned presence, while maintaining safe radiation levels, was favorably as-

sessed for nominal 25 to 100 kWe modular configurations. No feasibility limitations or technical barriers were identified and the use of both distance and indigenous planetary soil material for human rated radiation shielding were shown to be viable and attractive options.

14583 **(PNL-SA—15304) Cermet fuel reactors.** Cowan, C.L.; Palmer, R.S.; Van Hoomissen, J.E.; Bhattacharyya, S.K.; Barner, J.O. (General Electric Co., Fairfield, CT (USA); Argonne National Lab., IL (USA); Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 9p. (CONF-871234—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003945/JAW.

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

Cermet fueled nuclear reactors are attractive candidates for high performance space power systems. The cermet fuel consists of tungsten-urania hexagonal fuel blocks characterized by high strength at elevated temperatures, a high thermal conductivity and resultant high thermal shock resistance. Key features of the cermet fueled reactor design are (1) the ability to achieve very high coolant exit temperatures, and (2) thermal shock resistance during rapid power changes, and (3) two barriers to fission product release - the cermet matrix and the fuel element cladding. Additionally, thre is a potential for achieving a long operating life because of (1) the neutronic insensitivity of the fast-spectrum core to the buildup of fission products and (2) the utilization of a high strength refractory metal matrix and structural materials. These materials also provide resistance against compression forces that potentially might compact and/or reconfigure the core. In addition, the neutronic properties of the refractory materials assure that the reactor remains substantially subcritical under conditions of water immersion. It is concluded that cermet fueled reactors can be utilized to meet the power requirements for a broad range of advanced space applications. 4 refs., 4 figs., 3 tabs.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 14623, 14661, 14681, 14686, 14687

14584 **(NUREG—0386-Digest.4-Rev.7) United States Nuclear Regulatory Commission Staff practice and procedure digest: Commission, Appeal Board and Licensing Board Decisions, July 1972-March 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of the General Counsel). Dec 1987. 413p. NTIS, PC A18/MF A01 - GPO. Order Number TI88900269/JAW.

This Revision 7 of the fourth edition of the NRC Staff Practice and Procedure Digest contains a digest of a number of Commission, Atomic Safety and Licensing Appeal Board, and Atomic Safety and Licensing Board decisions issued during the period from July 1, 1972 to March 31, 1987 interpreting the NRC's Rules of Practice in 10 CFR Part 2. This Revision 7 replaces in part earlier editions and supplements and includes appropriate changes reflecting the amendments to the Rules of Practice effective through March 31, 1987.

14585 **(NUREG—0540-Vol.9-No.10) Title list of documents made publicly available, October 1-31, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Dec 1987. 431p. NTIS, PC A19 - GPO. Order Number TI88900265/JAW.

This document is a monthly publication containing descriptions of information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author, Corporate Source, Report Number, and Cross Reference to Principal Documents.

14586 **(NUREG—0750-Vol.25-No.5) Nuclear Regulatory Commission issuances, May 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). 1987. 465p. NTIS, PC A20/MF A01 - GPO. Order Number TI88900262/JAW.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

14587 **(NUREG—1256-Vol.1) Incentive regulation of nuclear power plants by state public utility commissions.** Petersen, J.C. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Dec 1987. 57p. NTIS, PC A04/MF A01 - GPO. Order Number TI88900233/JAW.

This report on incentive regulation of nuclear power plants by state public utility commissions (PUCs). Economic performance incentives established by state PUCs are applicable to the construction or operation of about 45 nuclear power reactors owned by 30 utilities in 17 states. The NRC staff monitors development of the incentives and periodically provides an updated report on all nuclear plant incentives to its regional offices. The staff maintains contact with the PUCs and the utilities responsible for implementing the incentives in order to obtain the updated information and to consider potential safety effects of the incentives. This report presents the NRC staff's concerns on potential safety effects of economic performance incentives. It also includes a plant-by-plant survey that describes the mechanics of each incentive and discusses the financial effects of the incentive on the utility-owner(s) of the plant.

14588 **(NUREG—1258) Evaluation procedure for simulation facilities certified under 10 CFR 55: Final report.** Wachtel, J.; Plott, C.; Laughery, K.R.; Gore, B.F. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Licensee Performance and Quality Evaluation). Dec 1987. 139p. NTIS, PC A07/MF A01 - GPO. Order Number TI88900247/JAW.

This document describes the procedure to be followed by the NRC for the inspection of simulation facilities certified by facility licensees under 10 CFR 55. Inspections are divided into four major areas based on the types of evaluations conducted: (1) performance testing; (2) physical fidelity/human factors; (3) control capabilities; and (4) design, updating, modification, and testing. NRC staff representing several disciplines including license examiners, operations specialists, and human factors experts, under the direction of a team leader, will perform these inspections. A simulation facility inspection may include off-site and on-site phases. The off-site phase will consist of an examination of the simulation facility documentation and an identification of those operations and procedures which may be considered for use in performance testing during the on-site phase. In the on-site review, the staff will work closely with the facility licensee to conduct a sound and fair inspection and to evaluate the results of tests that are conducted. Inspection findings will be based upon the staff's judgment of the simulation facility's compliance with 10 CFR 55.45. Findings may range from one of "no adverse impact on the conduct of operating tests" through degrees of "adverse impact requiring correction" to "adverse impacts so serious that the simulation facility may not be used in the conduct of operating tests until the discrepancies are corrected and the simulation facility is recertified to the NRC."

14589 **(NUREG—1262) Answers to questions at public meetings regarding implementation of Title 10, Code of Federal Regulations, Part 55 on operators' licenses.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Licensee Performance and Quality Evaluation). Nov 1987. 180p. NTIS, PC A09/MF A01 - GPO. Order Number TI88900250/JAW.

This document presents questions and answers based on the transcripts of four public meetings (and from written questions submitted after the meetings) conducted from April 9 to April 20, 1987

by the staff of the US Nuclear Regulatory Commission. The meetings discussed implementation of the Commission's final rule governing Operators' Licenses and Conforming Amendments (10 CFR Parts 55 and 50). The rule became effective May 26, 1987 and is intended to clarify the regulations for issuing licenses to operators and senior operators; revise the requirements and scope of written examinations and operating tests for operators and senior operators, require a simulation facility; clarify procedures for administering requalification examinations; and describe the form and content for operator license applications.

14590 **(NUREG/CR—2000-Vol.6-No.12) Licensee Event Report (LER) compilation: For month of December 1987.** (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 135p. (ORNL/NSIC—200-Vol.6-No.12). NTIS, PC A07/MF A01 - GPO. Order Number TI88005202/JAW.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-1061, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 - Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983.

14591 **(SAND—87-7139) Using PRA [probabilistic risk assessment] to define areas of possible exemption from regulatory requirements.** Kolaczkowski, A.; LaChance, J.; Ferrell, W.; Shapiro, B.; McFarlane, S. (Science Applications International Corp., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 198p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88004812/JAW.

This document summarizes work being conducted by Sandia National Laboratories (SNL) and Science Applications International Corporation (SAIC) for the Risk-Based Licensing Program sponsored by the Department of Energy (DOE). The objective of this work is to define and demonstrate an approach for identifying potential areas for exemption from current regulatory requirements to assist in the improvement of the regulatory process for future design reactors. A methodology using probabilistic risk assessment (PRA) and a demonstration of the methodology using an existing PRA are presented in this report.

2108 Economics

REFER ALSO TO CITATION(S) 14551, 14575, 14576, 14748, 14749, 14754, 14758

14592 **(INIS-mf—11095) Nuclear Power Day '86. Collection of papers.** (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 9 Dec 1986. 277p. (In Czech). (CONF-8610377—). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88701081/JAW.

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

The proceedings in two volumes of the event "Nuclear Power Day '86" held in the Institute of Nuclear Research, contain full texts of 13 papers which all fall under the INIS Scope. The objective of the event was to acquaint broad technical public with the scope of the State Research and Development Project called "Development of Nuclear Power till the Year 2000". The papers were mainly focused on increased safety and reliability of nuclear power plants with WWER reactors, on the development of equipment and systems for disposal and burial of radioactive wastes, the introduction of production of nuclear power facilities of an output of 1,000 MW, and on the construction of nuclear heat sources. (Z.M.).

14593 (INIS-mf—11095, pp 5-23) **Scientific and technical scope of Czechoslovak nuclear power development up to 2000.** Havelka, S.; Drahny, M. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia; Ceskoslovenska Komise pro Atomovou Energii, Prague). 9 Dec 1986. (In Czech). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88701081/JAW. (CONF-8610377—).

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

The scope is discussed of research and development work within the state project "Development of Nuclear Power till the Year 2000". The basic objective of the project is to create scientific and technical preconditions for guaranteeing the planned growth of electric power production and of heat supply from nuclear sources, the construction of nuclear power installations, and also the export of nuclear power equipment and instruments. Currently, the project involves 11 state projects and 3 branch projects. In addition, 6 further projects have been prepared whose solution will be started by 1990. Attention is paid not only to the construction of nuclear power sources but also to the problems of nuclear engineering, nuclear safety and to safeguards. It is stated that in spite of a considerable capacity concentrated in Czechoslovakia to the implementation of research and development work within this state project, the tasks could not be managed without international cooperation with the CMEA member countries, especially with the USSR. (Z.M.). 3 tabs.

14594 (INIS-mf—11095, pp 50-67) **Construction programme of nuclear power plants in Czechoslovakia.** Votruba, J. (Federalni Ministerstvo Paliv a Energetiky, Prague, Czechoslovakia). 9 Dec 1986. (In Czech). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88701081/JAW. (CONF-8610377—).

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

The plan of the development of nuclear power in Czechoslovakia envisages that in the year 2000 the installed capacity of nuclear power plants will reach 11,280 MW and in the year 2005 16,280 MW. The share of nuclear power plants in the total electric power production will thus be 53.8% in the year 2000 and 66.2% in the year 2005. It is also envisaged that these nuclear power plants will also be used to a considerable extent as heat supply sources. The economic requirements are discussed of various variants of covering the Czechoslovak power needs. The analysis shows that the variant based on the development of nuclear power is the least expensive. Briefly described are the locations of nuclear power plants which should be built following the construction of the Temelin plant. They include Kecerovce (Eastern Slovakia), Opatovice (Eastern Bohemia) and Blahutovice (Northern Moravia). (Z.M.). 2 tabs.

22 NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 14510, 14514

14595 (INDC(CCP)—274/L, pp 67-79) **Method and a program for automatic preparation of few-group constants for reactor calculations in three-dimensional hexagonal geometry.** Pivovarov, V.A.; Seregin, A.S. Jun 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700652/JAW.

Original report in Russian was distributed as INDC(CCP)-237/G.

In Translation of selected papers published in Nuclear Constants 5(59), 1984.

A method and a program are proposed for the automated preparation of few-group constants using 26-group calculation in three-dimensional hexagonal geometry. The distinctive feature of the method is the precise orientation of the multigroup calculation towards preparing few-group constants exclusively. Along with a natural simplification of the initial problem (large space lattice, reduced accuracy in termination of iterative process), this orientation has allowed approximations to be introduced through which the

few-group constants can be calculated in times that are acceptable in practice while maintaining adequate accuracy of the results obtained. For example, the BEhSM-6 computer takes 9 minutes to prepare 4-group macroconstants for the SNR-300 prototype reactor (FRG). The proposed method is carried out by the SERP83 program which is written in FORTRAN. 5 refs, 4 tabs. Translated from Russian.

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 14610, 14612, 14658, 14685

14596 (AEEW-R—2027) Validation study of the BURNUP and associated options of the MONTE CARLO neutronics code MONK5W. Howard, E.A. (UKAEA Atomic Energy Establishment, Winfrith). Nov 1985. 48p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750861/JAW.

This is a report on the validation of the burnup option of the Monte Carlo Neutronics Code MONK5W, together with the associated facilities which allow for control rod movements and power changes. The validation uses reference solutions produced by the Deterministic Neutronics Code LWR-WIMS for a 2D model which represents a whole reactor calculation with control rod movements.

14597 (ANL—87-42) Review of the analyses of the Doppler-effect measurements in SEFOR [Southwest Experimental Fast Oxide Reactor]. Ott, K.O. (Argonne National Lab., IL (USA)). Jul 1987. Contract W-31109-ENG-38. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004142/JAW.

The SEFOR experimental results and the three original analyses are reviewed and discussed. The emphasis of the review is placed on aspects that are pertinent to a possible modern re-analysis of the experimental results. Looking at the analysis results in terms of zero and first order effects shows that the zero order effects, the Doppler constant of the two SEFOR cores, are obtained by the three analyses in satisfactory agreement. But the first order effects, but temperature variation of this Doppler-constant quantity, cannot be determined with any informative accuracy. Since this is likely due to limitations in the experiments, a re-analysis - except for methodological reasons - does not appear to be fruitful. 17 refs., 8 figs., 7 tabs.

14598 (CEA-CONF—9035) APOLLO assembly spectrum code. Kavenoky, A.; Sanchez, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Apr 1987. 15p. (CONF-870424—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751344/JAW.

From American Nuclear Society international meeting on advances in reactor physics, mathematics and computation; Paris, France (27 Apr 1987).

The APOLLO code was originally developed as a design tool for HTR's, later it was aimed at the calculation of PWR lattices. APOLLO is a general purpose assembly spectrum code based on the multigroup integral transport equation; refined collision probability modules allow the computation of 1D geometries with linearly anisotropic scattering and two term flux expansion. In 2D geometries modules based on the substructure method provide fast and accurate design calculations and a module based on a direct discretization is devoted to reference calculations. The SPH homogenization technique provides corrected cross sections performing an equivalence between coarse and refined calculations. The post processing module of APOLLO generate either APOLLIB to be used by APOLLO or NEPLIB for reactor diffusion calculation. The cross section library of APOLLO contains data and self-shielding data for more than 400 isotopes. APOLLO is able to compute the depletion of any medium accounting for any heavy isotope or fission product chain. 21 refs.

14599 (CEA-CONF—9037) Mixed and mixed-hybrid elements for the diffusion equation. Coulomb, F.; Fedon-Magnaud, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Apr 1987. 12p. (CONF-870424—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751345/JAW.

From American Nuclear Society international meeting on advances in reactor physics, mathematics and computation; Paris, France (27 Apr 1987).

To solve the diffusion equation, one often uses a Lagrangian finite element method. We want to introduce the mixed elements which allow a simultaneous approximation of the same order for the flux and its gradient. Though the linear systems are not positive definite, it is possible to make them so by eliminating some of the unknowns.

14600 (EPRI-NP—5509-CCM) SIMTRAN-E: A SIMULATE-E to RETRAN-02 datalink. McClure, J.A.; Gose, G.C. (EI International, Inc., Idaho Falls, ID (USA)). Dec 1987. 255p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920125/JAW.

The Reactor Analysis Support Package (RASP) developed under EPRI sponsorship provides a verified and validated set of codes for use in reactor reload and safety analysis work. The principal codes in the RASP package include both physics and thermal-hydraulics production-type programs. In addition, RASP contains many linkage codes whose functions are to transcribe and modify information being passed between production codes. The SIMTRAN-E code is a member of the set of linkage codes in RASP which transcribes cross-section information from the reactor physics code SIMULATE-E for use in the operational transient code RETRAN-02. The SIMTRAN-E code converts the three-dimensional cross-section data generated from SIMULATE-E calculations into the form required for the RETRAN-02 thermal feedback models. This report describes the content and use of the SIMTRAN-E linkage code.

14601 (NIIAR—24-705) On the properties of solutions of some integro-differential problems of reactor dynamics. Makin, R.S. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1986. 58p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700936/JAW.

The conditions for completeness and summability of the root vectors in the spectral problem for the non-stationary system of the reactor kinetics integrodifferential equations in one-velocity approach with isotropic scattering have been determined. The results are generalized for energy dependence of cross sections. For nonlinear system describing reactor dynamics in a one-velocity kinetic approximation, taking into account delayed neutrons and dependence of cross sections on the medium temperature, existence of limit cycle (self-oscillations) is settled. In case of homogeneous medium and one-dimensional geometry it is proved that for investigated dynamical system the succession of bifurcations in the period-doubling is obeyed to the universal Feigenbaum's law. 70 refs.; 2 figs.

14602 (NIIAR—29-710) Subroutines for solving the equation of diffusion in media with anisotropic properties. Grachev, V.D.; Mel'der, R.R. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700743/JAW.

Calculational method and subprograms realizing the solution of the diffusion equation in the medium with anisotropic properties are described. Finite element method using piece linear approximation of test functions is used. Application of local coordinate systems related with main axes of anisotropy when analyzing diffusion processes in anisotropic media is shown to simplify substantially the problem statement and its solution. Using the subprograms described, one calculated the field of the coolant rate in the space between fuel elements and the temperature field of fuel, a shell and a coolant. The subprograms enter the complex of the subprograms of

thermo-physical calculation of radiation devices and fuel assemblies of nuclear reactors. 7 refs.; 4 figs.

14603 (PNL-SA—14610) Reflections on the criticality of special actinide elements. Clayton, E.D. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 8p. (CONF-871045—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003418/JAW.

From International seminar on nuclear criticality safety; Tokyo, Japan (19 Oct 1987).

During recent years, the list of nuclides known to be capable of supporting a chain reaction has substantially increased. Since the criticality aspects for some of these nuclides differ in important respects from those of the most common fissile nuclides, $^{235}_{92}U$, and $^{239}_{94}Pu$, a new term, "fissible" was recently proposed in nuclear engineering to help distinguish differences. Activation energies for fission have been calculated for 41 of the actinide isotopes which are grouped according to four types of nuclides, those with even-Z, even-N, odd-Z, odd-N, odd-Z, even-N, and even-Z, odd-N. With the possible exception of $^{237}_{92}U$, all fissible isotopes listed have even N. The activation energy for fission is less in the case of the even-Z, even-N isotopes, but almost without eception it is the odd-N isotopes that undergo fission with thermal neutrons and which constitute the principal criticality problem. This paper reviews the criticality and fissionability aspects of the fissile and fissible actinide isotopes. The criticality of aqueous mixtures of fissile and fissible isotopes also is briefly discussed, including limits for criticality control.

14604 Few-group representations of the energy spectra of delayed neutrons. Brady, M.C.; England, T.R. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **54**: 342-344(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The importance of delayed neutrons in reactor calculations has been well established. A recent evaluation of delayed neutron data has resulted in the compilation of a reference library containing emission probabilities, Pn's, and energy spectra for ~ 272 individual precursor nuclides. The library may be used to calculate aggregate spectra and total delayed neutron yields for various fission systems by applying summation techniques. It is common practice in reactor calculations to use a few-temporal group (e.g., six) representation of delayed neutron data. The above-mentioned library has been analyzed in terms of group yields and half-lives for 3, 6, 9, and 12 delayed neutron groups. However, the few-group representation cannot be considered completed until the energy spectra are represented in a consistent manner. The purpose of this paper is to present the method and results of the few-group analysis of the energy spectra.

14605 Source of correlated noise in experiments using a ^{252}Cf source. Difilippo, F.C. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **54**: 349-350(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The $^{2}\%^{2}Cf$ source method to measure reactivities is under intensive study, both theoretically and experimentally, at the Oak Ridge National Lab. Potential applications to the measurement of very large subcriticalities require a careful analysis of the source of correlated noise. Still, ^{252}Cf experiments are analyzed by applying the Schottky prescription of the source of noise according to Cohn, i.e., without corrections due to the neutrons removed by the detector; this is equivalent to assuming that detector fluctuations are exactly proportional to the fluctuation of the neutron field. If this is true, a nonzero correlation should be measured in a moderator driven by a one-neutron-per-event source, which certainly is not the case. Sheff and Albrecht emphasized later that the Schottky source of noise has to be divided into two components related to multiple neutrons per event (fission) and to a single neutron per event (absorption plus leakage), and that only the first component is the source of correlated noise for the detector. The differences between the two formalisms have very practical implications when the ^{252}Cf method is applied to measure large subcriticalities. In this paper the authors analyze systems without multiplication in order to emphasize the differences; also additional sources of correlations due to finite resolution time are individualized and quantified. Whenever possible, a master equation approach is used to avoid a posteriori cosmetic to the Langevin/Schottky approach.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 14994

14606 (AEEW-R—1725) Improvements to the electrical insulation resistance of high quality magnesia insulated cables. Mauger, R.A.; Goodings, A. (UKAEA Atomic Energy Establishment, Winfrith). Mar 1984. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750956/JAW.

Mineral insulated signal cables for nuclear reactor instrumentation schemes have to meet stringent electrical insulation requirements at high temperatures. This report discusses the factors which influence the attainment of this objective and the way in which it has been reached under industrial manufacturing conditions. It emphasises the importance of moisture and gives details of the improvements achieved as a result of moisture reduction.

14607 (CEA-CONF—9154) Influence of operation incidents on the French training programme. Cernes, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Apr 1987. 13p. (CEA-DAS—354; CONF-8704249—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751720/JAW.

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

The French Electricity Producer (EDF) and the Safety Authorities have developed, each of his own, a procedure for analysing the operating incidents. One of the major lessons of their analysis was the importance of incidents due to human error and, among them, to deficiences in the training of the operators. It is, in consequence, particularly important to improve the quality of these programmes and one of the major concerns is how to take into account the lessons of operation experience. Our purpose is aimed at describing how this is now done.

14608 (CONF-8710111—20) Effects of commercial cladding on the fracture behavior of pressure vessel steel plates. Iskander, S.K.; Alexander, D.J.; Bolt, S.E.; Cook, K.V.; Corwin, W.R.; Oland, B.C.; Nanstad, R.K.; Robinson, G.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004333/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The objective of this program is to determine the effect, if any, of stainless steel cladding upon the propagation of small surface cracks subjected to stress states similar to those produced by thermal shock conditions. Preliminary results from testing at temperatures 10° and 60°C below NDT have shown that (1) a tough surface layer (cladding and/or HAZ) has arrested running flaws under conditions where unclad plates have ruptured, and (2) the residual load-bearing capacity of clad plates with large subclad flaws significantly exceeded that of an unclad plate.

14609 (EPRI-NP—5511) Fracture toughness characterization of Type 410 stainless steel: Final report. Hiser, A.L. (Materials Engineering Associates, Inc., Lanham, MD (USA)). Nov 1987. 71p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920111/JAW.

Type 410 stainless steel has been used as an alternative material for bolts and studs because of its mechanical properties and corrosion resistance. However, failures have occurred in 410 stainless steel that have prompted further studies to characterize the properties of the failed material. After the discovery of failed valve studs by Virginia Power, investigation of the failures focused on improper heat treating of the studs, resulting in temper embrittlement. (The studs were purchased to ASTM specification A 193 Grade B6, with a supplemental requirement of 125 ksi tensile strength.) To assess the fracture properties of the stud material, pieces of several

failed studs were sent to Materials Engineering Associates, Inc. Characterization of the material was performed using impact tests (Charpy-V notch specimens), strength tests (tensile specimens), and static fracture toughness tests (compact tension specimens). The strength tests revealed 0.2% offset yield and ultimate strengths exceeding ASTM and Virginia Power requirements, although the reduction-of-area requirement was satisfied in only three of six tests. The impact tests revealed low toughness, with 20 ft-lb and 20% shear not eclipsed until 430°F. Test results at 550°F indicate an upper shelf in excess of 80 ft-lb. The static fracture toughness tests exhibited cleavage failure from 40°F to 200°F, with low toughness at 40°F and 120°F. Higher toughness was observed at 200°F, with the onset of the static upper shelf probably occurring between 300°F to 400°F. 2 refs., 10 figs., 4 tabs.

14610 **(FEI—1687) Pade approximation of cross sections in cells with burnable poisons.** Budarina, S.V.; Vtorova, O.Yu.; Isakova, L.Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700841/JAW.

Construction method for approximations of additional absorption cross sections that are introduced when changing consideration of heterogeneous cells with strong-shielded burnable poisons to consideration of homogenized cells, is presented. To approximate cross sections Pade approximation is used. Approximations are constructed in the space of three variables. A brief description of PADE1 program realizing the described algorithm is presened. Program is witten in FORTRAN language for BESM-6 computer language for BESM-6 computer. 6 refs.; 7 figs.

14611 **(NUREG/CR—5023) High-level seismic response and failure prediction methods for piping.** Severud, L.K.; Anderson, M.J.; Lindquist, M.R.; Wagner, S.E.; Weiner, E.O. (Westinghouse Hanford Co., Richland, WA (USA)). Jan 1988. Contract AC06-87RL10930. 219p. (WHC-EP—0081; HEDL-TME—86-11). NTIS, PC A10/MF A01 - GPO. Order Number TI88005178/JAW.

Seismic response and failure analyses were performed for four piping systems that were shake-tested to high level nonlinear and inelastic response levels. Both pre- and post-test analyses were accomplished. A number of simplified elastic, elasto-plastic, and inelastic transient dynamic analysis methods were utilized. Descriptions of these methods, with their special structural parameters and comparisons of predictions using each method to test data, are provided. Reasonably useful, but conservative, methods were found for predicting the high-level inelastic response and the failure modes.

14612 **(NUREG/CR—5049) Pressure vessel fluence analysis and neutron dosimetry.** Kam, F.B.K.; Maerker, R.E.; Williams, M.L.; Stallmann, F.W. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 63p. (ORNL/TM—10651). NTIS, PC A04/MF A01 - GPO. Order Number TI88004475/JAW.

A review of the various methodologies used by industries and research institutes for reactor pressure vessel (RPV) fluence determination shows that most organizations employ an analysis sequence consisting of three steps. These include transport calculations, dosimetry measurements, and a statistical procedure to combine the calculations and measurements to arrive at a fluence value which has a smaller uncertainty than the original calculations. An accurate determination of damage fluence accumulated by the RPV as a function of space and time is essential in order to ensure the vessel integrity for both pressurized thermal shock transients and end-of-life considerations. The desired accuracy for neutron exposure parameters such as displacement per atom or neutron fluence ($E > 1.0$ MeV) is of the order of +-10% to +-15% (1σ). these types of accuracies can only be obtained realistically by validation of the entire analysis sequence in benchmark experiments. This report identifies a standardized procedure based on benchmarked calculations, data, and dosimetry measurements, which could be used by organizations performing RPV fluence determinations. Another purpose of this report is to provide supporting documentation for any proposed regulatory guide on this subject. 33 refs., 8 figs., 10 tabs.

14613 **(TPRD/B—0846/R86) Example of an application of an assessment procedure for defects in plant operating in the creep range.** Ainsworth, R.; Coleman, M.C. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750324/JAW.

A worked example is presented to illustrate the application of a CEGB procedure for the assessment of defects in plant that operates within the creep range. The example chosen is a large cylindrical pressure vessel with a fully circumferential crack for which experimental results are available. The example demonstrates that it is straightforward to perform the calculations required in the procedure for the time for structural failure by continuum damage mechanisms, the time for crack incubation and the time for crack growth. It is predicted that crack incubation in the pressure vessel occurs at about one-third of life with the remaining life being taken up by crack growth. The predictions are in close agreement with the experimentally observed incubation, growth and final failure times.

14614 **Procedure for determining the SSE response from the OBE response.** Curreri, J. (Brookhaven National Lab., Upton, NY, USA. Dept. of Nuclear Energy). pp 553-558 of Transactions of the 8th international conference on structural mechanics in reactor technology. Vol. K(a). Seismic response analysis of nuclear power plant systems. Stalpaert, J. (ed.). Amsterdam, Netherlands; North-Holland (1985). (EUR—10001-DE/EN/FR; CONF-850809—).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Current procedures that are used in implementing R.G. 1.61 frequently result in an OBE response that is greater than the SSE response. This is because the higher damping under the SSE is used at all stress levels, low as well as high. This is obviously not the intent of the Regulatory Guide. A procedure has been developed which derives an expression relating the SSE response in the OBE response. Two factors are involved in the equations. The first involves the damping ratios for the SSE and OBE events and the second is the ratio between the levels of the OBE and SSE.

2203 Fuel Elements

14615 **(AERE-R—12210) TRAFIC-2- a modified version of the TRAFIC fuel performance code.** Laney, A.R.; Thetford, R. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). May 1986. 16p. H.M. Stationery Office, London, price Pound 4.00.

The report describes the development of new numerical techniques for the TRAFIC fuel performance code. The new code, designated TRAFIC-2, couples the mechanical and heat-transfer calculations more strongly. This has the potential for increased stability and larger time steps in the calculation, with only a minor cost penalty for each step.

14616 **(EUR—10756) Work on URGAP models for calculation of heat transfer between fuel and cans.** Lassmann, K.; Hohlefeld, F. (Commission of the European Communities, Luxembourg). 1986. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751586/JAW.

The URGAP fuel-cladding gap conductance model has been extended and revised generally in the following areas: extension to further fill gases (helium, argon, krypton, xenon, nitrogen, hydrogen, oxygen, carbon monoxide, carbon dioxide and (steam); extension to further fuel surfaces UO/sub 2/, (U, Pu)O/sub 2/, UC, (U,Pu)C, UN, (U,Pu)N and cladding surfaces Zr, ZrO/sub 2/, Fe (steel), Fe/sub 3/O/sub 2/; gas data (thermal conductivities, viscosities, Sutherland constants, accomodation coefficients) were carefully checked; the underlying theory was slightly modified, especially the importance of the accomodation coefficients was investigated; improvement of the programming; Recalibration using an extended gap conductance data bank. With the revised URGAP model the gap conductance for very different conditions such as material pairings, gas and contact pressure, surface roughness of fuel and cladding, gap width, gas temperature and composition are very satisfac-

tory described. URGAP may be used in any code describing the fuel rod behaviour of any reactor type.

14617 (NIIAR—15(661)) Calculated and experimental substantiation of the thermal method for non-destructive testing of fuel elements. Maksimov, N.M.; Soldatenko, V.A.; Petrovichev, V.I.; Salimov, S.E.; Aleksandrov, K.A.; Kurov, D.A. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 32p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700268/JAW.

The main systems and methods of thermal testing, their potentialities and advantages, thermal irradiation photodetectors are described. Possible fields of application of thermal testing in nuclear engineering are discussed. Calculations of the fuel element nonstationary temperature field in the three-dimensional geometry in the presence of such an effect as fuel exfaliation from cladding are presented. The developed method and equipment for fuel element thermal testing are described. Preliminary experimental data being in agreement with the calculated ones and opening the prospects for flaw detecting are presened. 40 references, 13 figures, 1 table.

14618 (NUCLEBRAS-CDTN—579) Simulation of the measure of the microparticle size distribution in two dimensions. Lameiras, F.S.; Pinheiro, P. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1987. 26p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700278/JAW.

Different size distributions of plane figures were generated in a computer as a simply connected network. These size distributions were measured by the Saltykov method for two dimensions. The comparison between the generated and measured distributions showed that the Saltkov method tends to measure larger scattering than the real one and to move the maximum of the real distribution to larger diameters. These errors were determined by means of the ratio of the perimeter of the figures per unit area directly measured and the perimeter calculated from the size distribution obtained by using the SaltyKov method.

2204 Control Systems

14619 (AEEW-R—1409) Control rod interaction models for use in 2D and 3D reactor geometries. Bannerman, R.C. (UKAEA Atomic Energy Establishment, Winfrith). Nov 1985. 64p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750890/JAW.

Control rod interaction models are developed for use in two-dimensional and three-dimensional reactor geometries. These models allow the total worth of any combination of control rods inserted to be determined from the individual worths in conjunction with an algorithm representing interaction effects between them. The validity of the assumptions is demonstrated for fast and thermal systems showing modelling errors of 1% or less in inserted control rod worths. The models are ideally suited for most reactor systems.

14620 (BMU—1986-131) Compatibility of existing nuclear rules and guidelines with progressive instrumentation and control and concepts. Gossner, S. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1986. 54p. (In German). (GRS-A—1208). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Compliance with existing requirements, necessity of modification of requirements or establishment of new requirements for the use of new I and C equipment is evaluated. The following results were obtained: 1) The existing basic requirements for safety related I and C equipment in NPP can be generally met by new I and C equipment. Some definitions (e.g. redundancy, diversity) and requirements laid down in nuclear rules are loosing their clearness when being applied to new I and C equipment and must be reworded. 2) Microelectronic devices are of a complex internal structure and the possibility of complete failure detection and of analysis of failure causes performed by users and experts is very low or almost absent. This must be compensated by an increased quality assurance (e.g. application of programming rules, more systematical collection and evaluation of experiences from operational use) by failure tolerating measures (e.g. diversity) and by failure detecting measures (e.g. self-checking programs). 3) Processive I and C equipment have characteristics which are not covered adequately by requirements in nuclear rules (e.g. process control with the help of graphic display terminals, light pens, touch panels). Therefore it seems necessary to adapt nuclear rules to new I and C equipment.

14621 (DOE/NE/37959—13) Signal validation in nuclear power plants: Progress report No. 4. Upadhyaya, B.R.; Kerlin, T.W. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). 28 Dec 1987. Contract AC02-86NE37959. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004248/JAW.

This report summarizes the progress in the Signal Validation Project during the last quarter of 1987 and contains a comprehensive description of the various signal validation modules. These modules are ready for implementation using plant operational data. A set of data has been acquired from Northeast Utilities Services Company's Millstone-3 PWR. Discussions are underway to acquire a database of EBR-II operational signals. These data will be used to evaluate the generalized consistency checking (GCC) and the process empirical modeling (PEM) modules.

14622 (DOE/NE/37965—T2) An artificial intelligence system for assisting nuclear power plant operators in the diagnosis of and response to plant faults and transients. Hajek, B.K.; Stasenko, J.E.; Bhatnagar, R.; Hashemi, S. (Ohio State Univ., Columbus (USA). Dept. of Mechanical Engineering). Dec 1987. Contract AC02-86NE37965. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004212/JAW.

This report discusses the Artificial Intelligence (AI) system being developed using the Conceptual Structures and Representation Language (CSRL) developed at the Ohio State University Laboratory for Artificial Intelligence Research (LAIR). This system combines three sub-systems which have been independently developed to perform the tasks of: detecting changes in the state of the plant that may lead to conditions requiring operator response, and then managing the actions taken by the other two subsystems; diagnosing the plant status independent of alarm states by analyzing the status of basic operating parameters such as flow rates, pressures, temperatures, and water levels, and providing a determination of the validity of sensor indications; and providing and/or synthesizing an appropriate procedure for the operator to follow to correct the transient or abnormal state of the plant. These three systems are tied into the main plant computers, including both the process computer and the safety parameter and display system computer, through the use of a compatible database. The architecture of the system is shown in Figure 1. The system is being developed using the Perry Nuclear Power Plant (a BWR/6) as the reference plant, and the General Electric ERIS and GEPAC Plus systems as key data sources. Scenarios are run on the Perry plant referenced simulator for testing of the AI system. Future testing plans call for the system to be interfaced directly to the Perry simulator.

14623 (EPRI-NP—5504-Vol.1) Simulator qualification plan: Volume 1, Methodology: Final report. Pellechi, M.S.; Schmidt, P.M. (General Physics Corp., Columbia, MD (USA)). Nov 1987. 91p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920112/JAW.

Qualification of a nuclear power plant training simulator involves both validation and verification. Response of the simulator in duplicating various training scenarios are validated against reference plant data, similar plant data, engineering code output data, or best estimate judgment. Verification involves confirming the accuracy of the simulator. The EPRI plan for simulator qualification described in this report details the procedures to validate the performance of the simulator and to verify its compliance with applicable regulatory requirements. An estimate of the resources to conduct

this plan is included as are the necessary forms to document performance. 7 refs., 25 figs.

14624 **(ORNL/TM—10662) Optimal control theory of load-following and parameter-tracking of nonlinear systems: An application of Pontryagin Maximum Principle to reactor dynamics.** March-Leuba, C.; Perez, R.B. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004770/JAW.

A demand-following and parameter tracking algorithm has been developed which utilizes the Pontryagin Maximum Principle (PMP). Starting from a variational principle, we have derived the methodology for the construction of a Hamiltonian function, with the analytical properties required by the application of the Pontryagin Maximum Principle method to Free Terminal Time optimization problems. A crucial result has been the conversion of the two point boundary value problem, typical of the Pontryagin Maximum Principle method for nonlinear systems, into a noniterative initial value problem. The introduction of sensor signals information, as a set of differential equations complementing the model's equation, allows the reformulation of parameter tracking algorithms as control optimization problems, where the demands are the plant signals, and the controls the time-varying plant parameters. The present algorithm allows correction for the time delays which affect the information flowing from the plant. The control algorithm presented in this paper has been validated against a nonlinear mode of a nuclear power plant with time-varying parameters. 10 refs., 5 figs., 1 tab.

14625 **(SAND—87-7175C) Experimental evaluation of the MIT-SNL period-generated minimum time control laws for the rapid adjustment of reactor power.** Bernard, J.A.; Kwok, K.S.; Menadier, P.T.; Thome, F.V.; Wyant, F.J. (Massachusetts Inst. of Tech., Cambridge (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-880122—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003792/JAW.

From 5. symposium on space nuclear power systems; Albuquerque, NM, USA (11 Jan 1988).

The rapid adjustment of reactor neutronic power has recently been achieved by developing control laws that determine the actuator mechanism velocity necessary to produce a specified reactor period. Designated as the 'MIT-SNL Period-Generated Minimum Time Control Laws,' these relations are closed-form expressions of general applicability. In particular, if there is no limitation on the available rate of change of reactivity, these laws can be used to achieve virtually any desired power profile including time optimal ones. The innovative aspect of these laws is that the rate of change of reactivity rather than the reactivity itself is used as the control signal. For example, relative to a time-optimal response, these laws function by altering the rate of change of reactivity so that the instantaneous period is stepped from infinity to its minimum allowed value, held at that value until the desired power level is attained, and then stepped back to infinity. The response is time-optimal because the power adjustment is continuously made at the maximum allowed rate.

14626 **(UFRJ-COPPE-PEN—129) Methods of uncertainty propagation used in the analysis of safety sistems of Angra-1: a comparison.** Fleming, P.V.; Oliveira, L.F.S. de; Senna, V. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). Nov 1984. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700284/JAW.

It's presented the summary of the codes developed by COPPE, and the conclusions from the use of each one of them to some of the systems considered in the Angra-1 PRA.

14627 **(WHC-SA—0137) Incore neutronic fluctuation measurements in a large graphite moderated power reactor.** Crowe, R.D.; Toffer, H.; Albrecht, R.W. (Westinghouse Hanford Co., Richland, WA (USA); Washington Univ., Seattle (USA)). Oct 1987. Contract AC06-87RL10930. 8p. (CONF-871013—6). NTIS, PC A02. Order Number DE88004469/JAW.

From 5. SMORN: international conference on reactor noise; Munich, F.R. Germany (12 Oct 1987).

Neutronic fluctuation measurements were made in various locations in the N Reactor core. Although the reactor is very quiet, some interesting features were observed: autospectra that increase in amplitude at low frequencies and exhibit a relatively broad resonant peak at about 0.3 Hz; coherence between all measured locations that shows a relatively broad peak with a value of about 0.8 at 0.3 Hz; zero phase shifts between detectors placed at a common position along the flow stream; linear phase shifts at low frequencies for detectors placed in an upstream/downstream configuration whether or not the detectors are in the same radial location and regardless of the radial locations of the detectors; and a space and time dependent resonant feature at about 1.4 Hz which has strong coherence between selected detectors. Computer calculations were made to explain some of these observations with only limited success. This paper discusses the results achieved up to this time.

14628 **Interpretation of spatial effects in reactivity measurements with the ^{252}Cf source noise method.** Difilippo, F.C. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 642-643(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The ^{252}Cf method has been used extensively to measure reactivities in a large variety of situations ranging from a fast reactor mock-up to thermal homogeneous systems. The method is now being applied to arrays of cans (containing fissile solutions) and pieces of uranium metal. The geometrical complications of these kinds of arrangements preclude the use of interpretive models based on a point reactor or on a bare reactor eigenfunction expansion approach. The original limitations of both approaches can be overcome if we develop models based, respectively, on a phenomenological multipoint reactor formalism or on a postulated eigenfunction expansion. This paper describes the calculation of stochastic observables with a lumped two-point and a continuous two-mode reactor model.

14629 **Response of EBR-II's delayed neutron monitoring systems during sinusoidal reactivity-oscillation experiments.** Gross, K.C.; Drenth, L.K. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 643-644(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Multifrequency reactivity-oscillation experiments were recently performed during operation with an exposed fission source in Experimental Breeder Reactor II (EBR-II). The purpose of these experiments was to evaluate the response characteristics of EBR-II's delayed neutron (DN) monitoring systems under a broad range of transient power and transient temperature conditions. A secondary objective was to verify that EBR-II's fission product source (FPS) capsules, which are being supplied to foreign reactors for calibration of their fission product monitoring systems, are pure recoil sources - i.e., that the fission product release rate is directly proportional to the product of the fission rate and surface area under both steady-state and transient temperature conditions. A detailed analysis of the results from these experiments has demonstrated that (a) EBR-II's DN monitoring systems are very sensitive and have excellent counting statistics; (b) they are highly linear with respect to power variations and are unaffected by concomitant variations in DND temperature; and (c) they can accurately follow transient release rate variations over a broad frequency range.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 14530, 14656, 14657, 14661, 14672, 14677, 14688, 14690, 14695, 16096, 16220

14630 **(AERE-R—12163) Environmental impact of particles emitted from Windscale Piles 1954-1957.** Chamberlain, A.C. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Apr 1986. 32p. HMSO, London, price Pound 5.00.

During 1954-7 particles of irradiated uranium oxide were emitted from the Windscale Piles. From measurements of activity in soil in 1958 onwards, it is estimated that about 12 kg of uranium, 20 Ci of ^{137}Cs, 18 Ci of ^{90}Sr and 0.3 Ci of $^{239+240}Pu$ were emitted. To estimate the concentrations of ^{90}Sr and ^{137}Cs in milk during the emissions, comparison is made with the fallout of fission products from bomb tests, which also began in 1954, but continued longer. It is calculated that the average level of ^{90}Sr in milk at Seascale, 1954-7 was 36 pCi per g Ca, with higher concentrations, 100 to 200 pCi $(g\ Ca)^{-1}$, in milk from farms immediately surrounding the Windscale plant. For comparison, in 1963/5 the average level of ^{90}Sr in milk in the UK was 20 to 30 pCi $(g\ Ca)^{-1}$, with 90 to 170 pCi $(g\ Ca)^{-1}$ in milk from certain hill farms. Since the oxide particles were larger than those derived from bomb tests, and the conditions of deposition different, an extended review is given (Appendix 1) of the factors determining the entry of radioactive or stable contaminants from fallout into food chains.

14631 (CEGB-TPRD/B—0754/R86) Quality assurance aspects of the environmental code NECTAR. Macdonald, H.F.; Nair, S.; Mascall, R.A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Feb 1986. 62p. (ODMWG/P—85-18-Rev.2). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750868/JAW.

This report describes the quality assurance (QA) procedures which have been adopted in respect of the Environment code NECTAR (Nuclear Environmental Consequences, Transport of Activity and Risks). These procedures involve the verification, validation and evaluation of the individual NECTAR modules, namely RICE, SIRKIT, ATMOS, POPDOS and FOODWEB. The verification and validation of each module are considered in turn, while the final part of the report provides an overall evaluation of the code. The QA procedures are designed to provide reassurance that the NECTAR code is free from systematic errors and will perform calculations within the range of uncertainty and limitations claimed in its documentation. Following consideration of a draft version of this report by the Off-site Dose Methodology Working Group, the ATMOS, POPDOS and FOODWEB modules of NECTAR have been endorsed for use by the Board in reactor design and safety studies.

14632 (CEGB-TPRD/B—0812/R86) Critical group doses arising from routine aquatic discharges of activity from the Heysham 2 nuclear power station. Maul, P.R. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750929/JAW.

An assessment of critical group doses arising from routine discharges of activity to sea from the Heysham 2 nuclear power station has been undertaken using the CODAR2 computer program. The largest critical group dose rate was calculated to be 50 μSv/y, about 80 per cent of which arose from the external exposure of individuals occupying intertidal sediments of the Lune Estuary from the single nuclide ^{60}Co. CODAR2 employs a single well mixed local compartment for critical group calculations and can not include the effects of processes varying over the compartment. A more detailed study of the critical group exposure has been carried out using recently developed methods to assess the uncertainties and pessimisms involved in the CODAR2 calculations. It is concluded that these calculations are pessimistic by about a factor of 2, with a reference calculation using the more detailed methods giving a dose rate of 23 μSv/y for the Lune Estuary group. Further reductions in the dose estimate might be possible if site specific measurements of the concentration factor for Co on estuarine sediments and the sedimentation rate in the Lune Estuary could be made.

14633 (DOE/ER/04014—17) University of Florida Training Reactor: Annual progress report, September 1, 1986-August 31, 1987. Vernetson, W.G. (Florida Univ., Gainesville (USA). Dept. of Nuclear Engineering Sciences). Nov 1987. Contract AC05-76ER04014. 135p. (ORO—4014-17). NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88004099/JAW.

The University of Florida Training Reactor's overall utilization for the past reporting year (September 1986 through August 1987) has returned to the increased levels of quality usage characteristic of the two years prior to the last reporting year when the maintenance outage to repair sticking control blades reduced availability for the year to near 50%. Indeed, the 91.5% availability factor for this reporting year is the highest in the last five years and probably in the 27 year history of the facility. As a final statement on the effectiveness of the corrective maintenance last year, the overall availability factor has been over 94% since returning to normal operations. The UFTR continues to experience a high rate of utilization in a broad spectrum of areas with total utilization continuing near the highest levels recorded in the early 1970's. This increase has been supported by a variety of usages ranging from research and educational utilization by users within the University of Florida as well as other researchers and educators around the state of Florida through the support of the DOE Reactor Sharing Program and several externally supported usages. Significant usage has also been devoted to facility enhancement where a key ingredient for this usage has been a stable management staff. Uses, reactor operation, maintenance, technical specifications, radioactive releases, and research programs are described in this report.

14634 (IAEA-TECDOC—416) Manual on quality assurance for the survey, evaluation and confirmation of nuclear power plant sites. (International Atomic Energy Agency, Vienna (Austria)). Apr 1987. 132p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700182/JAW.

The present Manual on Quality Assurance for the Survey, Evaluation and Confirmation of Nuclear Power Plant Sites contains supporting material and illustrates examples for implementing the requirements contained in the Code of Practice on Quality Assurance for Safety in Nuclear Power Plants to the activities of survey, evaluation and confirmation of nuclear power plant sites. At the same time the Code of Practice for Safety in Nuclear Power Plant Siting, and Safety Guides in the siting series contain requirements and recommendations to implement a quality assurance programme in selected activities of the siting process. This manual is intended to provide guidance and illustrate examples on this implementation. During preparation and reviews of this Manual it was found out that the methodology of implementation of the quality assurance programme in siting activities is still under development. For these reasons it was considered appropriate to publish this Manual as a temporary publication for trial use. 2 tables.

14635 (INIS-GB—107) Annual report on radioactive discharges and monitoring of the environment 1986. (British Nuclear Fuels plc., Risley. Health and Safety Directorate). 1987. 123p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751263/JAW.

British Nuclear Fuels plc (BNFL) provides a comprehensive range of nuclear fuel cycle services, ie the purification and processing of uranium ore concentrates, the enrichment of uranium, the manufacture of uranium and plutonium based fuels, the reprocessing of irradiated fuel, and the conditioning and storage of nuclear materials and radioactive wastes. Some of these activities give rise to discharges of radioactive isotopes to the environment. This annual report follows the pattern established in 1977 in that it gives information on radioactive discharges, through authorised and scheduled outlets, and on environmental monitoring for all of the Company's Works and sites, ie Sellafield Site and the Drigg Storage and Disposal Site; Chapelcross Works; Springfield Works and the Ulnes Walton Disposal Site; and Capenhurst Works. Where a site also encompasses laboratories of the United Kingdom Atomic Energy Authority (UKAEA) reference is made to the significance of the discharges from the latter. It also includes assessment of radiation doses to representative members of the most highly exposed group of the general population (the critical group) for the most important environmental pathways in the vicinity of each site. Information for the period 1971-76 inclusive has also been published by BNFL and prior to 1971, the year in which BNFL was formed, information was published by the UKAEA. An appendix contains certificates of Authorisation granted by the DOE, MAFF and Scottish Office imposing limits and conditions relating to methods of disposal and quantities to be discharged.

14636 (INIS-mf—11096, pp 181-198) **Nuclear power and the environment.** Dlouhy, Z.; Horyna, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 9 Dec 1986. (In Czech). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780047/JAW. (CONF-8610377—).

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

The environmental impacts and the impacts on man are compared for nuclear power plants and solid-fossil-fuel power plants. Practical experience points to significant advantages of nuclear power facilities. While coal-fired power plants in normal operation pollute the environment up to 30% of the permissible limits, the actual exposures caused by nuclear power plants are less than one per mille of the limits given by legal regulations. Some problems are also discussed of radiation protection. It is stated that thanks to the systematic research in this field which has been carried out for nearly sixty years, the knowledge of ionizing radiation hazards is now much more profound and complex than, e.g., that of toxic chemical pollutants released from fossil-fuel power plants and from chemical plants or contained in vehicle exhaust gases. (Z.M.). 5 tabs.

14637 (NUREG—0837-Vol.7-No.3) **NRC [Nuclear Regulatory Commission] TLD [Thermoluminescent Dosimetry] direct radiation monitoring network: Progress report, July-September 1987.** Struckmeyer, R.; McNamara, N.; Cohen, L. (Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I). Dec 1987. 224p. NTIS, PC A10 - GPO. Order Number TI88900267/JAW.

The US Nuclear Regulatory Commission (NRC) Direct Radiation Monitoring Network is operated by the NRC in cooperation with participating states to provide continuous measurement of the ambient radiation levels around licensed NRC facilities, primarily power reactors. Ambient radiation levels result from naturally occurring radionuclides present in the soil, cosmic radiation constantly bombarding the earth from outer space, and the contribution, if any, from the monitored facilities and other man-made sources. The Network is intended to measure radiation levels during routine facility operations and to establish background radiation levels used to assess the radiological impact of an unusual condition, such as an accident. This report presents the radiation levels measured around all facilities in the Network for the third quarter of 1987. A complete listing of the site facilities monitored is included. In some instances, two power reactor facilities are monitored by the same set of dosimeters (e.g., Kewaunee and Point Beach).

14638 (ORNL/TM—10362) **Characterization of solids in the Three Mile Island Unit 2 reactor defueling water.** Campbell, D.O. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 218p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88004508/JAW.

Because of the impact of poor water clarity on defueling operations at the Three Mile Island Unit 2 Nuclear Power Station, a study was undertaken to characterize suspended particulates in the reactor defueling water. The examination included cascade filtration through Nuclepore filters of progressively smaller pore sizes, using three water samples obtained at different times and after varying degrees of clarification. The solids collected on the filters were examined with a scanning electron microscope and analyzed with energy-dispersive x-ray fluorescence. A wide variety of solids was observed, and 26 elements were detected. These included all the materials expected from the reactor system (uranium, zirconium, silver, cadmium, indium, iron, chromium, and nickel), chemicals and zeolites used to decontaminate the water (aluminum, silicon, sodium), common impurities (potassium, chlorine, sulfur, magnesium, calcium, and others), as well as some unexpected metals (molybdenum, manganese, bromine, and lead). There was also evidence for the presence of organic material. A diverse assortment of particles with widely varying surface properties was found to be present.

14639 **Influence of foundation layering on soil-structure system motion.** Philippacopoulos, A.J.; Miller, C.A.; Costantino, C.J.; Graves, H.; Polk, H. (Brookhaven National Lab., Upton, NY, USA. Dept. of Nuclear Energy; City Coll., New York, USA. Dept. of Civil Engineering; Nuclear Regulatory Commission, Washington, DC, USA). pp 189-193 of Transactions of the 8th international conference on structural mechanics in reactor technology. Vol. K(a). Seismic response analysis of nuclear power plant systems. Stalpaert, J. (ed.). Amsterdam, Netherlands; North-Holland (1985). (EUR—10001-DE/EN/FR; CONF-850809—).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

This paper is concerned with effects on structural motion due to layering of the foundation. Impedance functions for foundations which consist of a layer resting on a viscoelastic half-space are used on a simple 3-dof SSI system and transfer functions are generated. It is shown that the layering of the foundation effects the motion of the SSI system. These effects are more pronounced for shallow layers with large difference in shear wave velocity from the underlying half-space.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 14625, 14633, 14650, 14675, 14679, 14703, 14995, 15382, 16036

14640 (AERE-R—11100) **Neutronics and thermal hydraulics feedback models of the Harwell materials testing reactors DIDO and PLUTO: I Neutronics analysis.** Javadi, M. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Physics and Metallurgy Div.). Oct 1986. 29p. H.M. Stationery Office, London, price Pound 5.00.

Neutronics modelling of the Harwell MTRs DIDO and PLUTO has been achieved in the WIMS-E framework using (r,z) and (x,y) two dimensional diffusion theory. The modelling takes into account fuel burnup and the presence of the coarse control arms and experimental rigs. The modelling is validated by comparisons with measurements of thermal and fast flux distributions.

14641 (INIS-GB—84) **[Universities Research Reactor, Risley, United Kingdom]: Annual report 1985-1986.** (Universities Research Reactor, Risley (UK)). 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750943/JAW.

The paper presents the annual report of the Universities Research Reactor, Risley, United Kingdom, for the period 1985-86. The contents of the report contains: the research programme, activation analysis service, teaching programme, and the reactor operation and safety arrangements. The research programme includes topics on: radiation biology, radiation chemistry, radionuclide migration, trace elements, gamma-ray penetration, reactor studies, neutron monitors, neutron activation, and ultracold neutrons. (U.K.).

14642 (INIS-mf—10795, pp 11-12) **Development of irradiation devices for the backfitted BER-II reactor.** Gawlik, D.; Gatschke, W.; Jacob, G.; Klein, J.; Rose, M.; Truong, Q.V. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H., Germany, F.R.). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

14643 (NIIAR—16(662)) **RITM device for fuel element testing under power ramping.** Kuprienko, V.A.; Pershin, A.V.; Spiridonov, Yu.G.; Sulaberidze, V.Sh.; Shulimov, V.N. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700269/JAW.

The RITM device for studying different aspects of nuclear fuel behavior under power ramping while testing fuel elements in the SM-2 reactor is designed and tested. An irradiation rig of the device permits to conduct simultaneous irradiation of three fuel element located in individual cooling channels. Thermal neutron flux density in the rig cells varies within 0.25-1.00 of the maximum value. The rate of fuel power increase in the 0.25-1.00 and 0.5-1.0 ranges equals 3-5 and 4-12% min. 6 references, 7 figures.

14644 **(NIIAR—17(663)) Results of the PG-2 steam generator life tests at the BOR-60 plant. Condition of heat transfer surfaces and tube bundle structural materials.** Sroelov, V.S.; Chernobrovkin, Yu.V.; Borisyuk, V.A.; Golovanov, V.N.; Bulanova, T.M.; Nikol'skij, R.V.; Britov, V.N. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700270/JAW.

Results of material testing and surface studying of heat transfer tubes of the PG-2 steam generator have operated for 15160 h at the BOR-60 plant in the mode of steam generation are described. Material of the evaporator (10Kh2M steel) is shown to be rather reliable for existing operating modes. The total rate of corrosion on part of the steam-water circuit is less than 0.03 mm/year. Material of steam superheater (Kh18N9 steel) undergoes aging. Approximately 80 μm deep cracks are found on the inner surface of tubes. Mechanical properties of the steel worsened.

14645 **(PB—88-136577/XAB) NBS (National Bureau of Standards) reactor: summary of activities July 1986 through June 1987. Technical note.** Shorten, F.J. (National Bureau of Standards, Washington, DC (USA). Reactor Radiation Div.). Nov 1987. 201p. (NBS/TN—1240). NTIS, PC A10/MF A01.

Also available from Supt. of Docs. as SN003-003-02834-7. See also report dated June 1983, PB—83-218636.

The report summarizes all those programs which use the NBS reactor. It covers the period for July 1986 through June 1987. The programs range from the use of neutron beams to study the structure and dynamics of materials through nuclear physics and neutron standards to sample irradiations for activation analysis, isotope production, neutron radiography, and nondestructive evaluation.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 14652, 14675

14646 **(AEEW-R—2104) Notes on the level of radioactive contamination in the Sellafield area arising from discharges in the early 1950's.** Jakeman, D. (UKAEA Atomic Energy Establishment, Winfrith). Jul 1986. 38p. H.M. Stationery Office, London, price Pound 6.00.

District radioactivity surveys made in 1955-7 around the Windscale Piles were interpreted then as indicating a total release of 400g of irradiated uranium. It is now believed that only recently deposited particles were detected, significantly underestimating the magnitude of the release. Later milk and soil samples in 1957-1961 indicated the release was in the region of some tens of kilograms. Based on these data the NRPB deduced doses and risks to children born and living around Sellafield, and some of these results are included. This report is published on behalf of Dr. Jakeman by the UKAEA.

14647 **(JAERI-M—87-148) GENGTC-JB: a computer program to calculate temperature distribution for cylindrical geometry capsule.** Someya, Hiroyuki; Kobayashi, Toshiki; Niimi, Motoji; Hoshiya, Taiji; Harayama, Yasuo. (Japan Atomic Energy Research Inst., Tokyo). Sep 1987. 28p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751981/JAW.

In design of JMTR irradiation capsules contained specimens, a program (named GENGTC) has been generally used to evaluate temperature distributions in the capsules. The program was originally compiled by ORNL(U.S.A.) and consisted of very simple calculation methods. From the incorporated calculation methods, the program is easy to use, and has many applications to the capsule design. However, it was considered to replace original computing methods with advanced ones, when the program was checked from a standpoint of the recent computer abilities, and also to be complicated in data input. Therefore, the program was versioned up as aim to make better calculations and improve input method. The present report describes revised calculation methods and input/output guide of the version-up program.

14648 (ZfK—594, pp 48-52) **Rossendorf Research Reactor - a nuclear device in the department of large-scale devices of the CINR.** Hieronymus, W.; Schneider, B.; Guenther, J.; Findeisen, A.; Franke, K. Jul 1987. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780042/JAW.

In Publications from the department of large-scale devices of the Central Institute of Nuclear Research at Rossendorf.

The development of the Rossendorf Research Reactor from 1972 up to 1985 is described. Some results of the work performed at this reactor are reported.

14649 **Design of the NRAD reactor core to optimize beam current.** Wetzel, L.L.; Imel, G.R. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **54**: 353-354(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

A design of a modified core for the Neutron Radiography (NRAD) Reactor that increases the beam current for radiography is presented in this paper. The NRAD (a TRIGA reactor) is located at the Argonne National Labs. Idaho site. The present NRAD core is a rectangular arrangement consisting of sixty-one 70% enriched (^{235}U) fuel lifetime improvement package (FLIP) fuel elements with three non-fuel-followed control rods in an 8 x 8 matrix. Two beam tubes, perpendicular to each other, extend from the core edge to separate radiography stations. Ten graphite reflector blocks are placed around the core.

14650 **Analysis of ZPPR experiments supporting production of ^{60}Co in FFTF.** Wootan, D.W.; Carter, L.L.; Rawlins, J.A.; Schaefer, R.W.; Maddison, D.W. *Transactions of the American Nuclear Society;* **54**: 377-379(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

An effort to expand the irradiation mission of the Fast Flux Test Facility (FFTF) beyond testing fuels and materials for the liquid-metal reactor (LMR) program included a study of the feasibility of producing commercial quantities of ^{60}Co. The ^{60}Co would be produced by neutron capture in assemblies containing an array of natural cobalt pins and hydrogen-bearing moderator pins located at the periphery of the FFTF core. Adding hydrogenous material to the assemblies enhances ^{60}Co production by slowing neutrons into energy ranges where the ^{59}Co capture cross section is higher. Some of the moderated neutrons leak from the moderated region to adjacent fuel regions, increasing local fission rates. In order to validate calculated fission rates and establish calculational biases and uncertainties, experiments were conducted in the zero-power plutonium reactor (ZPPR) to measure fission rates in fuel regions adjacent to a mock-up of a cobalt production assembly. The ZPPR experiment and analyses provided the technical basis for irradiating hydride-moderated assemblies in FFTF and a cobalt production cycle of FFTF with generally good agreement between measured and predicted reactivity worth and outlet temperatures in adjacent fuel assemblies. This experiment provides a benchmark configuration of a hydrogenous assembly in a fast reactor, with emphasis on the effect of the hydrogen on adjacent fuel. It is anticipated there will be other applications of hydride moderation in the development of future isotope production missions in FFTF.

2208 Propulsion Reactors

REFER ALSO TO CITATION(S) 14583

2209 Reactor Safety

REFER ALSO TO CITATION(S) 14339, 14520, 14587, 14590, 14591, 14611, 15435, 15439, 15514, 16036, 16088, 16203, 16947

14651 **(AEEW-R—1979) MABEL-2D: a code to analyse cladding deformation in a loss-of-coolant accident. Part 1: modifications following MABEL-2C.** Bowring, R.W.; Bryce, W.M.; Haste, T.J. (UKAEA Atomic Energy Establishment, Winfrith). Sep 1985. 56p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750884/JAW.

MABEL-2D is a code to predict the extent of cladding deformation in PWR fuel rods during a LOCA. An earlier version of the code, MABEL-2C, was issued in 1982, but this has been extensively modified. The modifications to convert MABEL-2C to MABEL-2D are described.

14652 **(AERE-M—3568) Comparisons of the emissions in the Windscale and Chernobyl accidents.** Chamberlain, A.C. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Feb 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750973/JAW.

The contents are summarized under the following headings: 1) Windscale accident summary 2) Emission of ^{137}Cs from Windscale 3) Emission of other fission products from Windscale 4) Environmental effects - iodine 5) Environmental effects - caesium. A bibliography is attached and where figures are available, comparisons are made with the Chernobyl fallout, including thyroid iodine burdens for U.K. students who were in Russia at the time of the Chernobyl accident, and milk measurements of Caesium ^{137} in the U.K.

14653 **(BMU—1986-136) Transient analysis for light water reactors. Final report.** Frisch, W.; Gill, R.; Hoeld, A.; Voggenberger, T.; Weber, J.P. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). 1986. 91p. (In German). (GRS-A—1172). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The performance of transient analyses in licensing has been evaluated with respect to methodology and completeness. The evaluations are based on the analyses performed during licensing, extended by additional transient analyses and the evaluation of systems and operational experience. As many details are plant-dependent, BWR and PWR have been treated separately. Own calculations have been carried out with the plant models ALMOD, ALMOD/GDE and ALMOS. The detailed studies did not show any deficiencies within the licensing rules. No major weak points of safety relevance have been detected in the methodology of transient analysis. Some minor improvements and additions are recommended.

14654 **(BMU—1986-140) Analysis and first evaluation of the course of the Chernobyl accident up to the excursion. Interim report.** Clemente, M.; Frisch, W.; Langenbuch, S.; Weber, J.P. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). 1986. 121p. (In German). (GRS-A—1289). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

This report contains a description and an evaluation of the course of the Tschernobyl accident up to the excursion. It is based on information obtained during the IAEA conference in Vienna in August 1986 and includes a first qualitative evaluation of the course of the accident as well as results of analyses carried out at GRS. This work was done with the aim to better understand the particular phases of the accident and to demonstrate the typical dynamic behaviour of the RBMK-1000 type reactor with a positive void coefficient in contrast to the behaviour of german BWRs with negativ void coefficients. The calculations also contribute to the evaluation of the consequences of the violations and errors executed by the operating team and the consequences of design weaknesses of the plant.

14655 **(BMU—1986-141) Studies of controlled venting of a PWR containment in case of severe accidents with meltdown.** Bracht, K.; Tiltmann, M. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1986. 85p. (In German). (GRS-A—1162). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

In the first part of the report results obtained for containment-venting in case of severe accidents especially in the USA are summarized. The second part contains the results of calculations where the effect of containment-venting for a german 1300 MW-PWR plant concerning accidents with core melt has been analysed. Different strategies of venting are discussed. The calculations show that venting can improve the hydrogen situation in the containment. Depending on the strategies the enrichment of hydrogen within the vent-system can exceed limits of deflagration or detonation. Venting of the containment for a limited time before or after the start of core melt will delay containment overpressurization about a day. An important effect on accident consequences is not expected by that delay. Only late venting to limit or reduce slowly the containment pressure and started for the first time immediately before a possible overpressurization of the containment may make sense. Venting of the containment atmosphere directly into the annulus is problematic and requires additional backfitting.

14656 **(BNL—40444) How safe are nuclear plants? How safe should they be?.** Kouts, H. (Brookhaven National Lab., Upton, NY (USA)). [1988]. Contract AC02-76CH00016. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004589/JAW.

It has become customary to think about safety of nuclear plants in terms of risk as defined by the WASH-1400 study that some of the implications for the non-specialist escape our attention. Yet it is known that a rational program to understand safety, to identify unsafe events, and to use this kind of information or analysis to improve safety, requires us to use the methods of quantitative risk assessment. How this process can be made more understandable to a broader group of nontechnical people and how can a wider acceptance of the results of the process be developed have been questions under study and are addressed in this report. These are questions that have been struggled with for some time in the world of nuclear plant safety. The Nuclear Regulatory Commission examined them for several years as it moved toward developing a position on safety goals for nuclear plants, a requirement that had been assigned it by Congress. Opinion was sought from a broad spectrum of individuals, within the field of nuclear power and outside it, on the topic that was popularly called, "How safe is safe enough?" Views were solicited on the answer to the question and also on the way the answer should be framed when it was adopted. This report discusses the public policy and its implementation.

14657 **(BNL-NUREG—40470) Potential problems associated with ion-exchange resins used in the decontamination of light-water reactor systems.** Soo, P.; Adams, J.W.; Kempf, C.R. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 17p. (CONF-8710111—16). NTIS, PC A03/MF A01. Order Number DE88004049/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

During a typical decontamination event, ion-exchange resin beds are used to remove corrosion products (radioactive and nonradioactive) and excess decontamination reagents from waste streams.

The spent resins may be solidified in a binder, such as cement, or sealed in a high-integrity container (HIC) in order to meet waste stability requirements specified by the Nuclear Regulatory Commission. Lack of stability of low-level waste in a shallow land burial trench may lead to trench subsidence, enhanced water infiltration and waste leaching, which would result in accelerated transport of radionuclides and the complexing agents used for decontamination. The current program is directed at investigating safety problems associated with the handling, solidification and containerization of decontamination resin wastes. The three tasks currently underway include freeze-thaw cycling of cementitious and vinyl ester-styrene forms to determine if mechanical integrity is compromised, a study of the corrosion of container materials by spent decontamination waste resins, and investigations of resin degradation mechanisms.

14658 **(BNL-NUREG—40498) Uncertainties in modeling and scaling in the prediction of fuel stored energy and thermal response.** Wulff, W. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 40p. (CONF-8710111—24). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003484/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The steady-state temperature distribution and the stored energy in nuclear fuel elements are computed by analytical methods and used to rank, in the order of importance, the effects on stored energy from statistical uncertainties in modeling parameters, in boundary and in operating conditions. An integral technique is used to calculate the transient fuel temperature and to estimate the uncertainties in predicting the fuel thermal response and the peak clad temperature during a large-break loss of coolant accident. The uncertainty analysis presented here is an important part of evaluating the applicability, the uncertainties and the scaling capabilities of computer codes for nuclear reactor safety analyses. The methods employed in this analysis merit general attention because of their simplicity. It is shown that the blowdown peak is dominated by fuel stored energy alone or, equivalently, by linear heating rate. Gap conductance, peaking factors and fuel thermal conductivity are the three most important fuel modeling parameters affecting peak clad temperature uncertainty. 26 refs., 10 figs., 6 tabs.

14659 **(CAPE—2999) Aperture cards: Sequoyah Nuclear Plant (Engineering Materials).** (Sandia National Labs., Albuquerque, NM (USA)). Feb 1987. Contract AC04-76DP00789. OSTI, PO Bx 62, Oak Ridge, TN 37831. Order Number TI87014228/JAW.

These aperture cards contain the accident sequence analyses for Sequoyah, Unit 1, one of the reference plants being examined as part of the NUREG-1150 effort by the Nuclear Regulatory Commission (NRC). NUREG-1150 will document the risk of a selected group of nuclear power plants. As part of that work, this report contains the overall core damage frequency estimate for Sequoyah, Unit 1, and the accompanying plant damage state frequencies. Sensitivity and uncertainty analyses provided additional insights regarding the dominant contributors to the Sequoyah core damage frequency estimate. The numerical-results are influenced by modeling assumptions and data selection for issues such as reactor coolant pump seal LOCA, common cause failure probabilities, and operator response to emergency conditions such as small LOCA and station blackout. The sensitivity studies explored the impact of alternate theories and data on these issues.

14660 **(CEA-CONF—9034) Expert systems for the analysis of transients on nuclear reactors: crisis analysis, sextant, a general purpose physical analyser.** Barbet, N.; Dumas, M.; Mihelich, G.; Souchet, Y.; Thomas, J.B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Apr 1987. 8p. (CONF-870424—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751343/JAW.

From American Nuclear Society international meeting on advances in reactor physics, mathematics and computation; Paris, France (27 Apr 1987).

Two developments of expert systems intended to work on line to the analysis of nuclear reactor transients are reported. During an hypothetical crisis occurring in a nuclear facility, a staff of the Institute for Protection and Nuclear Safety (IPSN) has to assess the risk to local population. The expert system is intended to work as an assistant to the staff. At the present time, it deals with the availability of the safety systems of the plant (e.g. ECCS), depending on the functional state of the support systems. A next step is to take into account the physical transient of the reactor (mass and energy balance, pressure, flows). In order to reach this goal as in the development of other similar expert systems, a physical analyser is required. This is the aim of SEXTANT, which combines several knowledge bases concerning measurements, models and qualitative behaviour of the plant with a mechanism of conjecture-refutation and a set of simplified models matching the current physical state. A prototype is under assessment by dealing with integral test facility transients. Both expert systems require powerful shells for their development. SPIRAL is such a toolkit for the development of expert systems devoted to the computer aided management of complex processes.

14661 **(CEA-CONF—9146) Consideration of hazards, earthquakes, aircraft crashes, explosions and fires in the safety of laboratories and plants.** Doumenc, A.; Faure, J.; Mohammadioun, B.; Jacquet, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Mar 1987. 37p. (In French and English). (CEA-DAS—338; CONF-8612119—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751718/JAW.

From OCDE, NEA/CSNI working group on the safety of fuel cycle; Salamanque, Spain (9 Dec 1986).

Although laboratories and plants differ from nuclear reactors both in their characteristics and sitings, safety measures developed for the hazards of earthquakes, aircraft crashes, explosions and fires are very similar. These measures provide a satisfactory level of safety for these installations.

14662 **(CEA-CONF—9152) Dynamic containment of gaseous effluents in the auxiliary buildings and reinjection of liquid effluents from these buildings back into the reactor building for 900 MWe PWRs under accident condition.** Demoulin, F.; Collinet, J.; Nguyen, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Mar 1987. 28p. (In French and English). (CEA-DAS—351; CONF-870411—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751719/JAW.

From Conference on nuclear containment; Cambridge, UK (6 Apr 1987).

Examination of the lessons to be learned from the accident of the Three Mile Island nuclear power plant on 20 March 1979 led the French Safety Authorities and EDF (Electricite de France) to adopt a series of measures intended to improve the performance of the containment of French PWRs, especially in the event of accident. Among the measures adopted, two of them contribute to the upgrading of the containment of nuclear island buildings, by reducing radioactivity constraints inside these buildings and by limiting radioactive releases into the environment. These are: (1) dynamic containment of auxiliary buildings likely to be contaminated following an accident, (2) reinjection back into the reactor building of liquid effluents arising in the auxiliary buildings. In this paper we shall discuss, for each measure, the approach to the problem and describe the arrangements made to arrive at a satisfactory solution.

14663 **(CEGB-TPRD/B—0796/R86) Preliminary assessment of individual doses in the environs of Berkeley, Gloucestershire, following the Chernobyl nuclear reactor accident.** Nair, S.; Darley, P.J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jun 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750866/JAW.

A preliminary assessment has been made of the individual doses to critical group members of the public in the environs of Berkeley arising from fallout resulting from the Chernobyl accident. The assessment was based on measurements of airborne radionuclide concentrations, ground deposition and nuclide concentrations in rainwater, tapwater, grass, milk and green vegetables. The committed effective dose-equivalent was found to be as follows:- Adult - 200 μSv, 1 year old child - 500 μSv, the 10 year old child

receiving a dose intermediate between these two values. The estimate accounts only for the nuclides measured and the specific exposure routes considered namely ingestion of milk and vegetables, inhalation and external exposure. However, it is believed that the inclusion of a range of other nuclides of potential significance, which may have been present but not measured, and potential intakes from additional routes is unlikely to increase the above estimates by more than a factor of 2.

14664 **(CEGB-TPRD/B—0809/R86) Environmental radioactivity measurements at BNL following the Chernobyl accident.** Hancock, R.; Woollam, P.B. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jun 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750865/JAW.

Measurements are reported of the concentrations at Berkeley in Gloucestershire of radioactivity in the air, rainwater, tap water, soil, herbage and fresh vegetables for the period 29 April 1986 to 15 May 1986, following the Chernobyl Power Station accident. Data for up to 18 gamma emitting isotopes are reported, together with some limited actinide-in-air measurements. Deposition velocities are calculated and an assessment is presented of the sensitivity of the techniques employed. Some data are also included on the gaseous composition of the cloud and the isotope dependent dose rate from deposition.

14665 **(EPRI-NP—5529M) An analytic model for pump performance in condensable two-phase flows: Executive summary, Final report.** Furuya, O.; Maekawa, S. (Tetra Tech, Inc., Pasadena, CA (USA)). Nov 1987. 59p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920114/JAW.

The performance of pumps under two-phase flow conditions drastically degrades compared to that of single-phase flow. The mathematical foundation, developed by one of the authors for noncondensable gas/liquid pump flows, is now extended to the condensable gas/liquid flow case. The results obtained with the newly developed theory compared well with existing test data for both mixed and radial flow pumps. The mechanism of head degradation was further clarified in relation to the gas condensation, centrifugal force and slip between two phases. 9 refs., 26 figs.

14666 **(EPRI-NP—5536) Risk-significant functional dependencies in PWRs: Final report.** Frank, M.V.; Fleming, K.N. (Pickard, Lowe and Garrick, Inc., Newport Beach, CA (USA)). Dec 1987. 180p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920137/JAW.

This report was inspired by the informal observation that functional dependencies among plant systems, particularly those between frontline safety systems and support systems, are often major contributors to the risks calculated in completed PRAs. This study provides evidence that this is indeed the case and seeks to determine how the risk impact of functional dependencies can be reduced in future nuclear power plant designs. Our insights have been summarized by a set of nine design principles that are not new to the nuclear industry and, indeed, have generally been implemented. Their risk significance, however, may not have been fully appreciated in the design process because of the usual practice of not emphasizing the beyond-design basis accidents. It is in pointing out the dependencies that are important to risk that both PRAs and this study make a contribution. 1 fig., 6 tabs.

14667 **(EPRI-NP—5546) Benchmark of Systematic Human Action Reliability Procedure (SHARP): Final report.** Joksimovich, V.; Spurgin, A.J. (NUS Corp., San Diego, CA (USA)). Dec 1987. 180p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920136/JAW.

This report presents the results of a research project sponsored by the Electric Power Research Institute (EPRI) on the benchmarking applications of Systematic Human Action Reliability Procedure (SHARP). Teams of analysts applied SHARP to an ATWS accident initiated by the loss of main feedwater. The benchmark was administered by a steering group, that devised the accident sequence, prepared the plant information base, the benchmark process and the questionnaire. Teams were selected from two of the leading PRA groups in the US; at a later date, a team from Electricite de France also participated in this Benchmark. The reports, produced by the teams, were benchmarked to see how closely the analysts were able to adhere to the steps, rules and activities of SHARP. The opinion of the teams on the usefulness of SHARP is as important as the ability of the teams to follow SHARP. A questionnaire was used to register the opinions of the analysts of the usefulness of SHARP in undertaking the human reliability assessment in a PRA. The results of the benchmark was that the teams followed the SHARP outline closely. The results of the questionnaire are that SHARP is both useful and easy to follow, however, the teams make recommendations for improvements to SHARP.

14668 **(EPRI-NP—5562) Analysis of anticipated transients without scram in severe BWR [Boiling Water Reactor] accidents: Final report.** Anderson, J.G.M.; Claassen, L.B.; Dua, S.S.; Garrett, J.K. (General Electric Co., San Jose, CA (USA)). Dec 1987. 90p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920145/JAW.

The recent interest in severe accidents in nuclear power plants has changed the focus from design basis events to the consequences of events beyond the design basis. In the General Electric BWRs, introduction of neutron absorbers into the reactor terminates the progression of ATWS events to severe accidents; however, if all neutron absorber systems were assumed to fail, an ATWS could progress to a severe accident. A limiting ATWS scenario has been analyzed which shows that extended periods of time for operator recovery actions are available prior to postulated severe core degradation or containment failure.

14669 **(EPRI-NP—5586) Thermal analysis of core barrel heating and coolant recirculation during core uncovery in PWR [pressurized water reactor] accidents: Final report.** Viskanta, R.; Chellaiah, S.; Moallemi, M.K. (Purdue Univ., Lafayette, IN (USA). Heat Transfer Lab.). Nov 1987. 99p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920143/JAW.

This report documents the development of two models and of computer codes intended to gain more complete understanding of the complex processes taking place in a PWR core under simulated, severe accident conditions. The knowledge should lead to more realistic computer system models for simulating loss of coolant accidents which result in severe undercooling transient and degraded cores. The primary attention is on the thermal hydraulics of the uncovered core rather than on the primary cooling system. This focus greatly simplifies the modeling and computational needs through elimination, as either irrelevant or unresolvable, of specific models for the balance of the primary and of the secondary reactor loop.

14670 **(IAEA-R—3773-F) Safety criteria: Intercomparison and aggregation of risks. Final report for the period 1 May 1984-31 October 1986.** Yadigaroglu, G. (International Atomic Energy Agency, Vienna (Austria)). Aug 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700610/JAW.

Review of the assumptions underlying the use of limit lines in nuclear regulation and risk comparisons led to an alternative approach, where frequency-consequence curves are divided into two components: number of accidents during a specified time period and consequences conditional upon the occurrence of an unwanted event. This approach leads to a neat separation between natural and technological disasters. To compare probability distributions when stochastic dominance principles are not applicable, risk indices based on a linearized moments model (LMM) were established. The LMM permits explicit introduction of individual, societal or group opinions, thus incorporating the various perceptions of risks by society directly into the evaluation process. A questionnaire was applied to elicit empirical data which were then compared with the predictions of the linearized moments model. Furthermore the LMM also allows the comparison of events in those cases where the cumulative probability distributions cross each other. For the

evaluation of a probability distribution that crosses the limit line, the risk index of the limit line (calculated by using the LMM) should be compared to the index of the accident under consideration. Refs, 1 fig, 4 tabs.

14671 **(INIS-GB—46) Chernobyl.** (Central Electricity Generating Board, London (UK)). 28 May 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750841/JAW.

This leaflet has been prepared by the Central Electricity Generating Board. Following the accident at Chernobyl nuclear power station in the Soviet Union people are concerned about the safety of the UK's nuclear power stations. This leaflet explains that Chernobyl is unlike any nuclear station operating or planned in the UK and under the CEGB's stringent safety rules it could not have been built in the UK. The leaflet explains what happened at Chernobyl and compares the RBMK design and British reactors. The bodies concerned with reactor safety are noted. The containment of radioactivity and emergency procedures are explained. The PWR design for Sizewell-B is stated to be much safer than the RBMK Chernobyl design.

14672 **(INIS-GB—49) Chernobyl.** Collier, J.G.; Davies, L.M. (Central Electricity Generating Board, Barnwood (UK). Generation Development and Construction Div.). Sep 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750835/JAW.

On April 26th 1986, the worst accident in the history of commercial nuclear power generation occurred at the Chernobyl Nuclear Power Station some 60 miles north of Kiev in the Ukraine. This article describes the sequence of events that occurred and the consequences of the accident. There was extensive damage to the Unit 4 reactor and the building which housed it. Some 31 people have died as a result of the accident either directly or as a result of receiving lethal radiation doses. A significant release of fission products occurred, contaminating land around the station and requiring the evacuation of around 135,000 people from their homes. The radioactive cloud generated over many days was carried by winds to all parts of Europe where there was a varying degree of public concern. The contamination resulted in restrictions on the consumption of meat and vegetables. The latent health effects may not be statistically significant when viewed against the normal mortality rate over the next 40 years.

14673 **(INIS-GB—86) Levels of radioactivity in Wales from the accident at Chernobyl, USSR on 26 April 1986. A compilation of the results of environmental measurements in Wales.** (Welsh Office, Cardiff (UK)). Jul 1986. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750953/JAW.

This document contains a compilation of the results of environmental monitoring for radioactivity and radiation in Wales following the accident at Chernobyl, USSR, on 26 April 1986. The compilation has been prepared by the National Radiological Protection Board at the request of the Welsh Office and includes all information available to the NRPB up to 23 May 1986. Data are presented under the following headings: Background information, concentrations in air, water (rain, surface, tapwater, non-potable), grass, outdoor dose rates, concentrations in cows, goats and ewes' milk, concentrations in leafy vegetables and other foods. (U.K.).

14674 (INIS-mf—11032, pp 21-28) **Problems of WWER-440 dynamic changes.** Rydzi, S. 1986. (In Slovak). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780032/JAW.

In VUPEK Newsletter 1/86.

The data processing capability of the DYNAMIKA program is presented and demonstrated for the calculation of coolant parameters and heat transfer variables of the WWER reactor in accident and transient modes of operation. An experimental outage is described of the TG 11 turbogenerator at the V-1 Jaslovske Bohunice nuclear power plant. The measured values were compared with values calculated using the DYNAMIKA program. The graphic representation makes it evident that the mathematical model comes very close to reality. (J.B.).

14675 **(JAERI-M—87-132) Material engineering aspects of postulated locations and scale of piping failures on JRR-2.** Sato, Takeshi; Tsuji, Hirokazu. (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 30p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751975/JAW.

As a part of modification of JRR-2 licensing review of nuclear facilities, postulated locations and scale of piping failures were examined in material engineering aspects. The conclusions are summarized as follows: (1) In the case of the failure of the natural circulation system valve, DV-5, which is one of the safety systems, adding to the piping failure, the failure of the inlet pipe, which is located about 6.8 m below a constant D/sub 2/O level and is made of aluminum base corrosion resistant alloy, will cause the largest scale of leakage of coolant. At the inlet pipe the through-wall leakage hole due to pitting should be assumed as 2 t in diameter (t:pipe wall thickness, the area is πt/sup 2/, i.e. about 3.4 cm/sup 2/). (2) In the case of the failure of the natural circulation system valve, DV-6 or DV-7, which is one of the safety systems, adding to the piping failure, the failure of the outlet pipe of the main D/sub 2/O circulating pump, which is located about 6.2 m below a constant D/sub 2/O level and is made of SUS304, will cause the largest scale of leakage of coolant. At the outlet pipe of the main D/sub 2/O circulating pump the through-wall leakage crack due to corrosion fatigue should be assumed as 1/2 center dot D in length and 1/2 center dot t in width (D:pipe diameter, t:pipe wall thickness, the area is 1/4 center dot Dt, i.e. about 6.3 cm/sup 2/).

14676 **(JAERI-M—87-174) Leakage flow characteristics of graphite seal mechanism with triangular cross-section for HTGR core support blocks.** Kaburaki, Hideo; Takizuka, Takakazu. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 21p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751996/JAW.

The prevention of coolant leakage flows is important for a thermal hydraulic design of a prismatic HTGR core. In particular, a seal mechanism for the core support blocks is necessary because gaps, which exist between core support blocks, induce leakage flows in the core. In this paper, a seal mechanism, which consists of graphite seal element with triangular cross-section and V-shaped seal seat, has been proposed. It is shown by the air flow experiments that the present seal mechanism is highly effective in preventing the leakage flows compared with the plate-type seal mechanism. It is also found that the pressure loss coefficient factor for this seal mechanism can be predicted by the effective end-gap area of the seal element.

14677 **(KFK—4278) NAUA Mod 5 and NAUA Mod 5-M. Two computer codes for the description of the behaviour in the containment system of a LWR after a core melt accident.** Bunz, H.; Koyro, M.; Schoeck, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Sep 1987. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751528/JAW.

This report gives a description and user's instruction of the computer codes NAUA Mod 5 and NAUA Mod 5-M. Their purpose is to calculate the behaviour of a polydisperse aerosol system in a closed container. This container can be subdivided in a number of subcompartments geometrically separated but coupled by gas flows. For the version Mod 5-M an arbitrary configuration of subcompartments and flow patterns can be treated. In the report the equations taken as basis of the two codes and the numerical solution methods are described as far as they are different from the methods used in the earlier versions of the code. Another main object of the report is a detailed explanation of the input and output of the codes.

14678 **(ND-R—1351(S)) Deformation, oxidation and embrittlement of PWB fuel cladding in a loss-of-coolant accident.** Parsons, P.D.; Hindle, E.D.; Mann, C.A. (UKAEA Risley Nuclear Power Development Establishment). Sep 1986. 226p. H.M. Stationery Office, London, price Pound 12.00.

The scope of this report is limited to the oxidation, embrittlement and deformation of PWB fuel in a loss of coolant accident in which the emergency core coolant systems operate in accordance with the design, ie accidents within the design basis of the plant. A brief description is given of the thermal hydraulic events during large and small breaks of the primary circuit, followed by the correct functioning and remedial action of the emergency core cooling systems. The possible damage to the fuel cladding during these events is also described. The basic process of oxidation of zircaloy-4 fuel cladding by steam, and the reaction kinetics of the oxidation are reviewed in detail. Variables having a possible influence on the oxidation kinetics are also considered. The embrittlement of zircaloy-4 cladding by oxidation is also reviewed in detail. It is related to fracture during the thermal shock of rewetting or by the ambient impact forces as a result of post-accident fuel handling. Criteria based both on total oxidation and on the detailed distribution of oxygen through the oxidised cladding wall are considered. The published computer codes for the calculation of oxygen concentration are reviewed in terms of the model employed and the limitations apparent in these models when calculating oxygen distribution in cladding in the actual conditions of a loss of coolant accident. The factors controlling the deformation and rupture of cladding in a loss of coolant accident are reviewed in detail.

14679 **(NRPB-R—195) Radiation doses to members of the population of Thurso.** Hill, M.D.; Cooper, J.R. (National Radiological Protection Board, Chilton (UK)). Jul 1986. 77p. H.M. Stationery Office, London, price Pound 6.00.

This report has been prepared at the request of the Reporter conducting the Public Inquiry in connection with an application by UKAEA and BNFL for outline planning permission for the construction and operation of a European demonstration fast-reactor-fuel reprocessing plant (EDRP) at Dounreay Nuclear Power Development Establishment (DNPDE), Caithness. It provides information on radiation doses to members of the population of Thurso in four age groups from the start of discharges at DNPDE in 1958 until 1984. The assessment takes into account all principal sources of radiation exposure including discharges to sea and atmosphere from DNPDE, discharges to sea from British Nuclear Fuels plc, Sellafield, fallout from nuclear weapons testing, natural background radiation and medical procedures. Doses via all of the main exposure pathways have been estimated either from measurements made in Caithness or elsewhere or, in the case of radionuclide discharges, by using mathematical models. The results show that discharges from DNPDE contribute only a small fraction of the total radiation dose received by members of the population of Thurso and thus a small fraction of the risk of radiation-induced health effects.

14680 **(NUREG—0852-Suppl.3) Safety evaluation report related to the final design of the Standard Nuclear Steam Supply Reference System: CESSAR System 80 (Docket No. STN 50-470).** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Projects III, IV, V and Special Projects). Dec 1987. 76p. NTIS, PC A05/MF A01 - GPO. Order Number TI88900257/JAW.

Supplement No. 3 to the Safety Evaluation Report for the application filed by Combustion Engineering, Inc., for a Final Design Approval for the Combustion Engineering Standard Safety Analysis Report (CESSAR) (Docket No. STN 50-470) has been prepared by the Office of Nuclear Reactor Regulation of the Nuclear Regulatory Commission. The purpose of this supplement is to update the Safety Evaluation by providing (1) the evaluation of additional information submitted by the applicant since Supplement No. 2 to the Safety Evaluation Report was issued and (2) the evaluation of the matters the staff had under review when Supplement No. 2 to the Safety Evaluation Report was issued.

14681 **(NUREG—0940-Vol.6-No.3) Enforcement actions: Significant actions resolved: Quarterly progress report, July-September 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Enforcement). Dec 1987. 214p. NTIS, PC A10/MF A01 - GPO. Order Number TI88900259/JAW.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (July-September 1987) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, so that actions can be taken to improve safety by avoiding future violations similar to those described in this publication.

14682 **(NUREG/CR—3495) Calculation of failure importance measures of basic events and plant systems in nuclear power plants.** Wheeler, T.A.; Spulak, R.G. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 491p. (SAND—83-0329). NTIS, PC A21/MF A01 - GPO. Order Number TI88004739/JAW.

This is a report on the project "Determination of Event Sequnces Contributing to Overall Frequency of Core Melt." It is an analysis of thirteen existing probabilistic risk assessments (PRAs) covering fifteen power plants. The object of this project is to identify the plant systems and system components which contribute most to the overall core melt frequency and to some measure of risk. The results of this analysis are grouped into the two major types of commercial reactors, Boiling Water Reactors (BWRs), and Pressurized Water Reactors (PWRs). Within each type of reactor, plants are grouped by manufacturer. The results are first analyzed on a plant by plant basis. Then, the results are discussed for all plants within each plant manufacturer type to study any interrelationships or common trends which might exist among plants built by the same manufacturer. The results are then discussed among all PWRs and all BWRs. The methodology developed for this analysis is based on dominant accident sequence cut sets comprised of system component level basic events. Only those accident sequences contributing five percent or more to the total core melt frequency or risk measure are considered as dominant in this analysis. These cut sets are taken directly from those PRAs which publish sequence cut sets. For those PRAs which did not include such logic models of the accident sequences, cut sets are taken from simplified fault trees developed from the sequence and system descriptions in the PRAs.

14683 **(NUREG/CR—4405) Probabilistic Risk Assessment (PRA) insights.** Fitzpatrick, R.; Arrieta, L.; Teichmann, T.; Davis, P. (Brookhaven National Lab., Upton, NY (USA)). Dec 1987. Contract AC02-76CH00016. 140p. (BNL-NUREG—51931). NTIS, PC A07/MF A01 - GPO. Order Number TI88005839/JAW.

Four different probabilistic risk assessments (PRAs) have been briefly reviewed with the broad objective of ascertaining what insights might be gained (beyond those already documented in the PRAs) by an independent evaluation. This effort was not intended to verify the specific details and results of each PRA but rather, having accepted the results, to see what they might mean on a plant-specific and/or generic level. The four PRAs evaluated were those for Millstone 3, Seabrook, Shoreham, and Oconee 3. Full detailed reviews of each of these four PRAs have been commissioned by the NRC, but only two have been completed and are available as further input to this study: the review of Millstone 3 by LLNL and the review of Shoreham by BNL. The review reported here focused on identifying the dominant (leading) initiators, failure modes, plant systems, and specific components that affect the overall core melt probability and/or risk to the public. In addition, the various elements of the methodologies employed by the four PRAs are discussed and ranked (per NUREG/CR-3852).

14684 **(NUREG/CR—4855) Development and application of a computer model for large-scale flame acceleration experiments.** Marx, K.D. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 79p. (SAND—87-8203). NTIS, PC A05/MF A01 - GPO. Order Number TI88004255/JAW.

A new computational model for large-scale premixed flames is developed and applied to the simulation of flame acceleration experiments. The primary objective is to circumvent the necessity for resolving turbulent flame fronts; this is imperative because of the relatively coarse computational grids which must be used in engineering calculations. The essence of the model is to artificially thicken the flame by increasing the appropriate diffusivities and decreasing the combustion rate, but to do this in such a way that the burn velocity varies with pressure, temperature, and turbulence intensity according to prespecified phenomenological characteristics. The model is particularly aimed at implementation in computer codes which simulate compressible flows. To this end, it is applied to the two-dimensional simulation of hydrogen-air flame acceleration experiments in which the flame speeds and gas flow velocities attain or exceed the speed of sound in the gas. It is shown that many of the features of the flame trajectories and pressure histories in the experiments are simulated quite well by the model. Using the comparison of experimental and computational results as a guide, some insight is developed into the processes which occur in such experiments. 34 refs., 25 figs., 4 tabs.

14685 **(PNL-SA—14609) Safety implications of anomalous effects of neutron absorbers on criticality.** Clayton, E.D. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 7p. (CONF-871045—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003417/JAW.

From International seminar on nuclear criticality safety; Tokyo, Japan (19 Oct 1987).

A number of "anomalies" in nuclear criticality have been disclosed in recent years, and as new data have become available additional anomalies have come to light. Application of existing data, without familiarity with the anomalies could lead to diminished criticality control, or more costly less efficient control. As neutron absobers are frequently used for criticality control, this paper briefly presents and discusses six apparent anomalies pertaining to the effect of neutron absorbers on the criticality of fissionable material.

14686 **(SAND—87-2050C) Use of containment event trees for NUREG-1150.** Breeding, R.J.; Griesmeyer, J.M.; Gregory, J.J.; Murfin, W.B.; Amos, C.N. (Sandia National Labs., Albuquerque, NM (USA); Technadyne Engineering Consultants, Inc., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 18p. (CONF-8710111—23). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003306/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

For the analysis of offsite risk for NUREG-1150, containment event trees (CETs) which are extremely large by past standards have been utilized. These CETs allow the processes that take place in the containment to be considered in much more detail than was previously possible. The CETs are evaluated by a computer code, EVNTRE, developed for this purpose. EVNTRE provides a sampling capability which allows uncertainty in the outcome to be calculated by evaluating the CET many times, with different values for the branching ratios and parameters in the CET which are uncertain. The pathways through the CET are grouped according to several attributes that provide the information required for the calculation of the source term. 11 refs., 3 figs., 1 tab.

14687 **(SAND—87-2061C) Revised accident progression and risk analyses for NUREG-1150.** Gorham-Bergeron, E.D.; Haskin, F.E.; Hora, S.C. (Sandia National Labs., Albuquerque, NM (USA); Hawaii Univ., Hilo (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-8710111—22). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003933/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Preliminary III PRA analyses that support preparation of the Nuclear Regulatory Commission's Reactor Risk Reference Document (NUREG-1150) have been conducted at Sandia National Laboratories for four plants: Surry, Sequoyah, Peach Bottom and Grand Gulf. Brookhaven National Laboratories conducted the analysis for the Zion plant. Review of the preliminary analyses produced comments and criticisms from two committees (Kouts Committee and Kastenberg Committee), from industry, and from a variety of other sources. As a result, the final analyses currently under way at Sandia and Brookhaven will contain several improvements over the preliminary analyses. Of these the most significant improvement is in the methodology used to elicit expert opinion concerning highly uncertain questions about severe accident phenomena. 17 refs., 1 fig., 1 tab.

14688 **(SAND—87-2063C) Ex-plant consequence assessment for NUREG-1150: Models, typical results, uncertainties.** Sprung, J.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 19p. (CONF-8710111—19). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003635/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The assessment of ex-plant consequences for NUREG-1150 source terms was performed using the MELCOR Accident Consequence Code System (MACCS). This paper will briefly discuss the following elements of MACCS consequence calculations: input data, phenomena modeled, computational framework, typical results, controlling phenomena, and uncertainties. Wherever possible, NUREG-1150 results will be used to illustrate the discussion. 28 refs., 14 figs., 6 tabs.

14689 **(SAND—87-2484C) Investigation of smoke corrosivity in nuclear power plant equipment.** Nowlen, S.P. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-8710248—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003808/JAW.

From International conference on the corrosivity of combustion products; London, UK (13 Oct 1987).

This paper presents certain results of fire safety research at Sandia National Laboratories (SNL). The work presented here is related to the issue of the development of standardized tests for determining the corrosive potential of materials when burned. This effort is associated with the investigation of the effects of fire on the operability of a nuclear power generating station and involves a number of programs. This paper will focus on information about five specific aspects of the corrosivity issue that has been gathered as a part of several individual experimental and analytical studies. These five topics are (1) the current perception of fire risk for nuclear power plants and the roll of corrosivity in that risk, (2) the composition of smoke particulate from large-scale enclosure cable fire tests, (3) the aging behavior of smoke particulate, (4) the effect of fire size on the physical characteristics of generated smoke particulate, and (5) electrical equipment fire exposure test results. 4 refs., 2 figs., 1 tab.

14690 **(SAND—87-2757C) Chemistry models in the VICTORIA code.** Grimley, A.J. III. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 24p. (CONF-871236—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88003630/JAW.

From Workshop on chemical processes and producers in severe reactor accidents; Captiva Island, FL, USA (9 Dec 1987).

The VICTORIA code is designed to be a module of the MELPROG severe accident analysis code. The functions of VICTORIA in MELPROG are fission product release from fuel, vapor-phase and aerosol physics, and chemical interactions involving fuel, structures, coolant, and aerosols. A stand-alone version of the code additionally provides independent capabilities for gaseous and aerosol transport within the coolant flow channel. The chemistry models within VICTORIA directly affect all the other functions of the code. This is due to the fact that chemical speciation and physical phase, both of which are determined in the chemistry calculation, are of fundamental importance in determining the characteristics of the various transport processes modelled in the re-

mainder of the code. For example, condensed phase species are not allowed to diffuse across the fuel-clad gap. Rather, only vapor-phase species can diffuse across the gap. The importance of the chemistry models to the other physical models in the code is established by the nature of the models used.

14691 **(SAND—87-7138) Integrated approach methodology: A handbook for power plant assessment.** Roush, M.L.; Modarres, M.; Hunt, R.N.M.; Kreps, D.; Pearce, R. (Maryland Univ., College Park (USA). Research Foundation; Baltimore Gas and Electric Co., Lusby, MD (USA). Analytical Support Unit; Combustion Engineering, Inc., Windsor, CT (USA)). Oct 1987. Contract AC04-76DP00789. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004910/JAW.

This handbook is a practical document that provides the principles and steps of a method to help a utility's decision-making process on matters concerning plant safety and economy. It provides a framework for analyzing the manner in which plant equipment and personnel work together to achieve successful operation; also making possible the quantitative evaluation of individual contributors to success in overall plant operation. The methodology does not purport to instruct utilities on the proper way to run a power plant. Rather, it is an analytical tool to aid a utility in using plant data and other hands-on knowledge of its own personnel to solve practical problems.

14692 **(SRD-R—384) New thermodynamic model of energetic molten fuel-coolant interactions.** Hall, A.N. (UKAEA Safety and Reliability Directorate, Culcheth). Jan 1987. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750328/JAW.

Price Pound 5.00.

A new thermodynamic model of energetic molten fuel-coolant interactions is presented, in which the response of fluid around the interaction zone is treated explicitly. By assuming that this fluid is compressed reversibly and adiabatically, a qualified lower limit to the efficiency of conversion of thermal energy to mechanical work is obtained. A detailed comparison of the model predictions with the results of the SUW series of experiments at AEE Winfrith is made. The predicted efficiencies are found to be in close agreement with those determined experimentally. Model predictions for a system of infinite volume are also presented.

14693 **(TPR-NS—29-No.1) Nuclear Safety: Technical progress review, January-March 1988.** Silver, E.G. (ed.). (Oak Ridge National Lab., TN (USA)). 1988. 118p. GPO. Order Number TI88000602/JAW.

This journal covers significant developments in the field of nuclear safety. Its scope includes the analysis and control of hazards associated with nuclear energy, operations involving fissionable materials, and the products of nuclear fission and their effects on the environment. Primary emphasis is on safety in reactor design, construction, and operation; however, the safety aspects of the entire fuel cycle, including fuel fabrication, spent-fuel processing, nuclear waste disposal, handling of radioisotopes, and environmental effects of these operations, are also treated.

14694 **(TPRD/B—0844/R86) Use of activity measurements in the plume from Chernobyl to deduce fuel state before, during and after the accident.** Longworth, J.P.; Tobias, A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1986. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750325/JAW.

Work performed at Berkely Nuclear Laboratories both prior to the meeting in Vienna at which USSR gave full details of the Chernobyl accident and after that meeting is recorded. Plume data from Western Europe were used to deduce the likely damage to the fuel and its previous irradiation history. The note concludes that the source to the environment consisted of an initial dispersion of fuel particulate followed by a prolonged release at a lower rate, the total release being some 3% of the core inventory of fuel. Early and late in the release period it was enhanced in volatile species. Damage to the fuel was thus due both to mechanical disruption and to high temperatures. During the early dispersive event high temperatures (probably approaching fuel melting) were reached in some of the core, though the proportion of the fuel affected may have been small.

14695 **(WHC-SA—0123-FP) GES [Ground Engineering System] test site preparation.** Cox, C.M.; Mahaffey, M.K.; Miller, W.C.; Schade, A.R.; Toyoda, K.G. (Westinghouse Hanford Co., Richland, WA (USA)). Oct 1987. Contract AC06-87RL10930;AC06-76FF02170. 15p. (CONF-870102—31). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004468/JAW.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Activities are under way at Hanford to convert the 309 containment building and its associated service wing to a nuclear test facility for the Ground Engineering System (GES) test. Conceptual design is about 80% complete, encompassing facility modifications, a secondary heat transport system, a large vacuum system, a test article cell and handing system, control and data handling systems, and safety andl auxiliary systems. The design makes extensive use of existing equipment to minimize technical risk and cost. Refurbishment of this equipment is 25% complete. Cleanout of some 1000 m^3 of equipment from the earlier reactor test in the facility is 85% complete. An Environmental Assessment was prepared and revised to incorporate Department of Energy (DOE) comments. It is now in the DOE approval chain, where a Finding of No Significant Impact is expected. During the next year, definite design will be well advanced, long-lead procurements will be initiated, construction planning will be completed, an operator training plan will be prepared, and the site (preliminary) safety analysis report will be drafted.

14696 **Sensitivity of in-vessel hydrogen generation and fission product release to parameter variations in a melt progression model.** Lee, M.; Khatib-Rahbar, M. (Brookhaven National Lab., Upton, NY). *Transactions of the American Nuclear Society;* **54**: 228-230(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The purpose of this paper is to determine the impact of the core meltdown model parameters on in-vessel hydrogen generation and radiological release for an anticipated transient without scram scenario in a boiling water reactor. As part of a continuing effort to quantify the radiological source term from a severe accident in a light water reactor, the US Nuclear Regulatory Commission (NRC) sponsored the development of the Source Term Code Package (STCP). In order to better establish the validity and potential applications of source term predictions from these codes, the Quantification and Uncertainty Analysis of Source Term for Severe Accidents in Light Water Reactors (QUASAR) program was initiated at Brookhaven National Lab. under the sponsorship of the NRC to quantify the uncertainties associated with the STCP calculated source term. The core melt progression model in the STCP is included in the MARCH code. The results of the sensitivity studies summarized. The in-vessel hydrogen generation and fission product release predictions are strongly influenced by the assumptions related to the core melt progression. Large uncertainties exist over a wide range of parametrics as shown in this paper.

14697 **Release and deposition of volatile fission products during in-pile severe fuel damage tests.** Vinjamuri, K.; Osetek, D.J. (EG & G Idaho, Inc., Idaho Falls). *Transactions of the American Nuclear Society;* **54**: 230-231(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Four in-pile severe fuel damage (SFD) tests have been conducted in the Power Burst Facility (PBF) at the Idaho National Engineering Lab. (INEL). These tests are part of the Severe Fuel Damage Source Term Research Program sponsored by the US Nuclear Regulatory Commission (NRC) and its international partners. The overall objectives of the SFD tests are to obtain the data necessary to understand fuel behavior, fission product behavior, and hydrogen generation during severe accidents. The four SFD tests were designed SFD-ST, SFD 1-1, SFD 1-3, and SFD 1-4. The fuel rods in each test were typical of 17 x 17 pressurized water reactor

fuel elements, except 1 m in length. The results presented in this summary indicate that the overall volatile fission product releases were lower then expected, considering the extreme conditions of the tests. Deposition on surfaces was significant, and all but tellurium was easily removed by water flushing. Tellurium was not released from the fuel bundles in large quantities except in Test SFD-ST, where significant cladding oxidation occurred. The preliminary results suggest that the effect of control rod materials on volatile fission product release from the fuel may be important. However, in the SFD 1-4 test, the greater aerosol source due to the present of control rod materials transported the volatile fission products farther downstream.

14698 **Inspection guidance for the Rancho Seco plant derived from generic PRA information.** Gore, B.F. (Pacific Northwest Labs., Richland, WA). *Transactions of the American Nuclear Society;* **54**: 233-234(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

This paper reports the first application of generic probabilistic risk assessment (PRA) information to the development of guidance for use in planning US Nuclear Regulatory Commission inspection activities at nuclear power plants lacking plant-specific PRA's. A methodology is presented for using the results of PRAs for similar (surrogate) plants, along with plant-specific information about the target and surrogate plants to infer important failure modes for systems and components of the target plant. This methodology, and the rationale on which it is based, is presented in the context of its application to Babcock and Wilcox (B & W) plants. The Rancho Seco plant has been analyzed using PRA information from two surrogate plants: Arkansas Nuclear One Unit 1 (ANO-1) and Oconee. Analysis results have been used to develop plant-specific Rancho Seco information for potential use by inspectors at NRC Region 5.

14699 **Generic safety insights for inspection of boiling water reactors.** Higgins, J.C.; Taylor, J.H.; Fresco, A.N.; Hillman, B.M. (Brookhaven National Lab., Upton, NY). *Transactions of the American Nuclear Society;* **54**: 234-236(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

As the number of operating nuclear power plants (NPPs) increases, safety inspection has increased in importance. Over the last 2 yr, probabilistic risk assessment (PRA) techniques have been developed to aid in the inspection process. Broad interest in generic PRA-based methods has arisen in the past year, since only ~ 25% of the US nuclear power plants have completed PRAs, and also, inspectors want PRA-based tools for these plants. This paper describes the Brookhaven National Lab. program to develop generic boiling water reactor (BWR) PRA-based inspection insights or inspection guidance designed to be applied to plants without PRAs.

14700 **NUREG-1150 risk assessment methodology.** Benjamin, A.S.; Amos, C.N.; Cunningham, M.A.; Murphy, J.A. (Sandia National Lab., Albuquerque, NM). *Transactions of the American Nuclear Society;* **54**: 236-237(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

This paper describes the methodology developed in support of the US Nuclear Regulatory Commission's (NCR's) evaluation of severe accident risks in NUREG-1150. After the accident at Three Mile Island, Unit 2, the NRC initiated a sever accident research program to develop an improved understanding of severe accidents and to provide a second technical basis to support regulatory decisions in this area. A key product of this program is NUREG-1150, which provides estimates of risk for several nuclear reactors of different design. The principal technical analyses for NUREG-1150 were performed at Sandia National Labs. under the Severe Accident Risk Reduction Program and the Accident Sequence Evaluation Program. A major aspect of the work was the development of a methodology that improved upon previous full-scale probabilistic risk assessments (PRA) in several areas which are described.

14701 **NUREG-1150 risk assessment results.** Benjamin, A.S.; Kunsman, D.M.; Boyd, G.J.; Lewis, S.R.; Amos, C.N.; Smith, L.N. (Sandia National Lab., Albuquerque, NM). *Transactions of the American Nuclear Society;* **54**: 238-240(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The methodology developed in support of the US Nuclear Regulatory Commission's (NRC's) evaluation of severe accident risks in NUREG-1150 is noted. This paper discusses the results. The principal technical analyses for NUREG-1150 were performed at Sandia National Labs. under the Severe Accident Risk Reduction Program and the Accident Sequence Evaluation Program. The analyses have been completed so far for four reference plants: (a) a pressurized water reactor (PWR) with a dry, subatmospheric containment (Surry Unit 1), (b) a PWR with an ice condenser containment (Sequoyah Unit 1), (c) a boiling water reactor (BWR) with a Mark I containment (Peach Bottom Unit 2), and (d) a BWR with a Mark III containment (Grand Gulf Unit 1). A fifth NUREG-1150 plant, a PWR with a large, dry containment (Zion Unit 1), has been evaluated separately by Brookhaven National Lab. Sample risk results for one of the plants (Surry) are presented. The results for Sequoyah, Peach Bottom, and Grand Gulf are broadly compared with those for Surry.

14702 **Results of recent TMI-2 distinct core component examinations.** Russell, M.L.; McCardell, R.K.; Jensen, S.M.; Akers, D.W.; Garner, R.W. (Idaho National Engineering Lab., Idaho Falls). *Transactions of the American Nuclear Society;* **54**: 244-245(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The US Dept. of Energy is sponsoring a Three Mile Island Unit 2 (TMI-2) accident evaluation program that is being conducted by EG & G Idaho, Inc., at the Idaho National Engineering Lab. One part of this program is examination of distinct core components, which is the subject of this paper. The TMI-2 distinct core component examination program focuses on core components with high potential for yielding information about the behavior of core materials and fission products. Nondestructive examinations including photography, neutron radiography, gamma spectroscopy scanning, and density and particle-size determinations were performed. The results of these examinations were invaluable in selecting components for destructive examinations. The destructive examinations include metallography with scanning electron microscopy, chemical analysis of core element abundance, and radiochemical analysis for fission products. The examination results discussed in this paper are related to the following components: (1) fuel assembly upper end fittings, (2) fuel rod upper and lower ends, and (3) control and burnable poison rod upper and lower ends.

14703 **Characterization of IFR metal fuel fragmentation.** Gabor, J.D.; Purviance, R.T.; Aeschlimann, R.W.; Spencer, B.W. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **54**: 251-253(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The integral fast reactor (IFR) employs a reactor design that has inherent safety features. An important safety advantage is derived from its pool configuration, which facilitates passive decay heat removal and isolates the core from accidents that might occur elsewhere in the plant. The metal-alloy fuel has superior heat transfer properties compared to oxide fuels. While the IFR design has these inherent safety features, a complete analysis of reactor safety requires assessment of the consequences of the melting of the uranium alloy fuel in the core and the contact of molten core materials with sodium. A series of eight tests was conducted in which the fragmentation and interaction behavior of kilogram quantities of uranium-zirconium alloy in sodium was studied.

14704 **Three-dimensional diffusion theory model of Chernobyl-4.** Heeb, C.M.; Lotz, T.L.; Doherty, A.L. (Pacific Northwest Labs., Richland, WA). *Transactions of the American Nuclear Society;* **54**: 382-383(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

A three-dimensional neutron diffusion theory model of the Chernobyl-4 RBMK reactor was developed to analyze the April 26, 1986, accident. The model provides a means to determine the reactivity worths of key reactor systems such as control rods and reactor coolant condition, as well as power distributions at various times during the accident scenario. Hence it is useful in evaluating proposed corrective action by the USSR. Initial applications of the model have focused on the scram rod worths as a function of insertion and the reactivity effect of increasing core steam void fraction. The model uses neutron diffusion theory in two energy groups. The 2-group spectrum-average macroscopic cross sections were calculated using the WIMS code. The Winfrith improved multigroup scheme was used. The cell spectrum calculation employed 69 energy groups, which were ultimately collapsed to the 2-group set used in the model. The 2-group macroscopic cross sections are dependent on fuel burnup, fuel temperature, and water density. Each node in the model can have different macroscopic cross-section values, which depend on nodal values of these three variables. Fuel channel water density calculations include the effects of subcooled as well as saturated coolant boiling. Fuel temperatures are also calculated for each fuel node. The model also contains nodal ^{135}Xe feedback.

14705 **Using robots to reduce personnel radiation exposure at the Savannah River Plant.** Taylor, R.M.; Lewis, W.I. III. New York, NY; American Institute of Chemical Engineers (1986). 15p. (CONF-860826—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Technical Paper 79A.

The Savannah River Laboratory is using robots to improve safety and reduce personnel radiation exposure in the nuclear process environment. This paper reviews several successful applications at this site. A detailed discussion is presented on an application to transfer materials in a line of shielded radiation work cells.

14706 **Comparison of risk assessment methodologies for nuclear power and nuclear fuels processing plants.** Durant, W.S.; Walker, D.H. New York, NY; American Institute of Chemical Engineers (1986). 22p. (CONF-860826—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Technical Paper 1B.

The utilization of nuclear fission for the generation of electric power or other purposes has as its by-product radioactive fission products. These radioactive fission products represent a potential hazard different in nature from that associated with other process operations or other methods of electrical power generation. As a result the electrical power stations and the facilities designed to process the irradiated fuel to recover the still useful fuel and the products of the irradiation are designed with multiple physical barriers to contain the radioactive fission products in the event that an accident were to occur. In recent years, a disciplined approach has evolved for developing detailed models of a facility and its processes. These models can be used to assess the response of the facility to upset or accident events. The approach is based on an ordered application of available data employing fault tree/event tree methodologies. Data and/or engineering judgment are applied in a probabilistic framework so the approach has been called Probabilistic Risk Assessment (PRA). The approach has been applied to nuclear power and nuclear fuels processing plants.

25 ENERGY STORAGE

2502 Compressed Gas

14707 **(EPRI-AP—5548) Thermal-cycling tests for a compressed-air energy storage recuperator: Final report.** Montgomery, M.E. (Encotech, Inc., Schenectady, NY (USA)). Dec 1987. 114p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920124/JAW.

The purpose of this investigation was to validate empirically an analytical procedure used to assess the fatigue life of compressed-air energy storage (CAES) recuperators when subjected to thermal cycling. A previous EPRI research project investigated the problem of thermal fatigue in CAES recuperators using finite-element analysis. This empirical investigation was performed to validate the results of that investigation. A scale model of a particular CAES recupertor tube-to-tubesheet joint was constructed. This model was subjected to thermal cycles representative of those expected in a CAES recuperator. Strains and temperature were measured and correlated with the strains and temperatures predicted by finite-element analysis. Visual and dye-penetrant inspections were performed on a periodic basis to detect the formation of fatigue cracks. In adition, periodic leak checks were performed to detect the propagation of crack growth through the depth of the tube-to-tubesheet-joint weld. Several cracks were detected, two of which penetrated the full weld depth before the desired useful life of CAES would be expended. Stress concentrations were calculated which correlate with those used in the finite-element analysis. Recommendations are given for the design of a tube-to-tubesheet joint for a CAES recuperator which should provide the desired fatigue life. 6 refs., 57 figs., 4 tabs.

2505 Flywheels

REFER ALSO TO CITATION(S) 14708

2506 Thermal

REFER ALSO TO CITATION(S) 14455, 14463, 15501

14708 **(CONF-880122—3) Energy storage for nuclear burst power systems.** Morris, D.G.; Olszewski, M. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003784/JAW.

From 5. symposium on space nuclear power systems; Albuquerque, NM, USA (11 Jan 1988).

Energy can be stored in a thermal energy storage (TES) medium and integrated into the heat rejection system to reduce the radiator size. This occurs by placing all or a significant fraction of the sprint reject heat into storage during burst operation. The stored heat is then rejected during the longer non-operational period of the orbit. Down-sizing of the radiator occurs because it is designed for an orbital average heat flux condition rather than the sprint peak. Alternatively, energy can be stored in regenerable electrical storage (RES) modules. In contrast to TES, these devices store input electrical energy produced by the primary power cycle, and later discharge electricity to the user. Since charging occurs over a time period much longer than discharging, the required primary power (and system mass) is significantly reduced. Assessment were performed for several nuclear sprint power concepts to determine if storage was of value in meeting burst power needs. Rankine power cycles and thermionic conversion systems were studied with various storage options. The value of energy storage was judged using total system mass as the criterion. These closed power systems (i.e. no effluents are discharged to space) were then compared to a nuclear, liquid hydrogen, open cycle, turboalternator system to determine the mass penalty for closing the primary power system.

14709 **(ORNL/TM—10413) Development of encapsulated lithium hydride thermal energy storage for space power systems.** Morris, D.G.; Foote, J.P.; Olszewski, M. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004762/JAW.

Inclusion of thermal energy storage in a pulsed space power supply will reduce the mass of the heat rejection system. In this mode, waste heat generated during the brief high-power burst operation is placed in the thermal store; later, the heat in the store is dissipated to space via the radiator over the much longer nonoperational period of the orbit. Thus, the radiator required is of significantly smaller capacity. Scoping analysis indicates that use of lithium hydride as the thermal storage medium results in system mass reduction benefits for burst periods as long as 800 s. A candidate design for the thermal energy storage component utilizes lithium hydride encapsulated in either 304L stainless steel or molybdenum in a packed-bed configuration with a lithium or sodium-potassium (NaK) heat transport fluid. Key issues associated with the system design include phase-change induced stresses in the shell, lithium hydride and shell compatibility, lithium hydride dissociation and hydrogen loss from the system, void presence and movement associated with the melt-freeze process, and heat transfer limitations on obtaining the desired energy storage density. 58 refs., 40 figs., 11 tabs.

2508 Chemical

14710 **(DOE/ER/04178—11) Photochemical energy storage: Studies of inorganic photoassistance agents: Progress report, April 1, 1985-October 30, 1987.** Wrighton, M.S. (Massachusetts Inst. of Tech., Cambridge (USA)). 1987. Contract AC02-76ER04178. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002596/JAW.

This progress report outlines research activities supported by DOE during the period April 1, 1985-March 31, 1988. The sections of the report give a brief outline of the major features of the work. Areas of work included are: photochemistry of semiconductor photoelectrodes; quinone-viologen redox polymers; high surface area biocatalysts; intramolecular electron transfer in a porphyrin-viologen molecule; and hydrophobic surface modifiers. (JDH)

2509 Batteries

REFER ALSO TO CITATION(S) 14708, 14708

14711 **(CONF-871027—41) Evaluation of advanced lead-acid batteries developed for load-leveling applications.** Miller, J.F.; Mulcahey, T.P. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002871/JAW.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Argonne National Laboratory has conducted an extensive evaluation of an advanced lead-acid battery developed by Exide Corporation for load-leveling applications. This paper presents the results of tests and analyses conducted on three 3100-Ah batteries over a five-year period. The Exide batteries demonstrated their high reliability and long life by completing over 2300 deep discharge cycles under accelerated life testing conditions at 50°C, the equivalent of over 6400 cycles or 25 years of operation for the electric utility application. This paper also describes the thermal characteristics and operational reliability of this battery technology.

14712 **(CONF-871121—1) Lead-acid load-leveling battery testing at Argonne National Laboratory.** Miller, J.F.; Mulcahey, T.P.; Christianson, C.C.; Marr, J.J.; Smaga, J.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002853/JAW.

From 8. battery and electrochemical contractors' conference; Tyson Corner, VA, USA (16 Nov 1987).

Argonne National Laboratory (ANL) has conducted an extensive evaluation of an advanced lead-acid battery development for load-leveling applications. The battery technology was developed by the Exide Corporation under a DOE-sponsored cost-shared R and D contract with ANL during 1979-1982. The objective of that program was to increase battery life from 2000 to 4000 deep discharge cycles while maintaining or reducing initial battery cost. Full-size, 3100-Ah cells were fabricated by Exide and assembled into one 6-cell and two 3-cell batteries. These 36-kWh and 18-kWh batteries were delivered to ANL in April 1982 for testing and evaluation. Southern California Edison is currently installing a 10-MW, 40-MWh load-leveling facility comprised of batteries based on this design.

14713 **(CONF-871121—3) Lithium/disulfide battery R and D.** Kaun, T.D.; DeLuca, W.; Lee, J.; Redey, L.; Nelson, P.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003032/JAW.

From 8. battery and electrochemical contractors' conference; Tyson Corner, VA, USA (16 Nov 1987).

The focus of molten-salt cell R and D in the past year at Argonne National Laboratory has been on developing an understanding of the excellent performance and stability of a lithium/disulfide cell using LiCl-LiBr-KBr electrolyte. For further improvement, we have initiated development of a rod-electrode cell design and design of cells which can tolerate overdischarge and overcharge abuse. Earlier Li/FeS_2 cells offered performance quite below expectations and had high capacity decline rates: 0.10 to 0.25% per cycle. Approaches for reducing the capacity decline rates of the earlier cells also reduced cell performance. However, our improved Li/FeS_2 cell tests indicate good prospects for attaining cell development goals of specific energy of 200 Wh/kg at a 4-h discharge rate, a specific power of 200 W/kg at 80% depth of discharge, and a cycle life of 1000 cycles. 3 figs., 1 tab.

14714 **(NEI-DK—51) Lithium battery with intercalation electrode.** Atlung, S.; Jacobsen, T.; Knutz, B.; Skaarup, S.; West, K.; Zachau-Christiansen, B. (Danmarks Tekniske Hoejskole, Lyngby. Fysik-Kemisk Inst.; Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Mar 1986. 151p. (In Danish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751083/JAW.

This report describes research at the Institute of Physical Chemistry and Physics Laboratory III, the Technical University of Denmark during the period January 1982 to March 1986. The goal of the work has been to demonstrate the feasibility of a solid state lithium battery employing intercalation electrodes and having a specific energy density higher than 100 Wh/kg for a 3 hour discharge. The research has been divided into three main areas: 1) Materials research. The emphasis has been on investigating new intercalation materials for positive electrodes and on crystalline electrolytes. 2) Mathematical modeling of electrochemical cells. Both analytical and simulation methods have been used for understanding and planning experiments and to suggest cell designs. 3) Cycling experiments. A number of test cells have been subjected to long term cycling in order to test the reversibility and transport properties of solid state cells. The material parameters most relevant to battery performance - e.g. the variation of the electromotive force with lithium concentration, the diffusion of Li/sup +/ ions, the electronic conductivity - have been measured for a number of intercalation compounds. Four types of electrolytes have been used: Liquid organic solutions, polymer electrolytes, lithium nitride and mixed phase electrolytes of the two latter. Simplified analytical models describing the discharge of the intercalation electrode both in the compact form and as part of a porous and a composite electrode have been developed. A large number of long term cycling experiments on solid state cells have been performed. (EG).

14715 **(PB—88-855200/XAB) Nickel-cadmium batteries. January 1977-December 1987 (citations from the NTIS data base). Report for January 1977-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 95p. NTIS PC N01/MF N01.

Supersedes PB—87-850152.

This bibliography contains citations concerning the design, fabrication, testing, and applications of nickel-cadmium batteries. Considerable attention is given to the evaluation and development of these batteries for aircraft and spacecraft environments. (This up-

dated bibliography contains 195 citations, 13 of which are new entries to the previous edition.)

14716 (SAND—87-2977C) Improving battery reliability by using regression trees. Thomas, E.V.; Jaeger, C.D.; Levy, S.C. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880133—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004539/JAW.

From 3. annual battery conference on applications and advances; Long Beach, CA, USA (12 Jan 1988).

One way to improve the reliability of primary cells is to use a screening procedure, based on nondestructive measurements, to eliminate cells that will yield poor performance. For a screening procedure to be effective, it is necessary that a relationship between the nondestructive measurements and future performance exists and be understood. Regression trees are used as a tool to model the relationship between nondestructuve measurements (in this case, parameters derived from complex impedance analysis) and performance. It is demonstrated that use of regression trees allows for discrimination between fresh and aged cells. 4 refs., 6 figs., 1 tab.

14717 (SV-UE-FUD—86-5) Comparative testing of lead-acid batteries in laboratory. Andersson, B. (Swedish State Power Board, Vaellingby). 2 May 1986. 144p. (In Swedish). NTIS (US Sales Only), PC A07. Order Number DE88751139/JAW.

Field tests of electric vehicles have been performed by the Swedish State Power Board since 1980. The experiences have shown the battery properties to be a problem area. A test of lead-acid batteries of different brands have therefore been performed at an independent testing institute in Denmark. Properties of special interest to vehicle applications have been tested, like the capacity under varying conditions, lifetime and mechanical strength. A theoretical battery model was worked out, that can serve for investigating the suitability of lead-acid batteries for electric vehicles. (L.E.).

29 ENERGY PLANNING AND POLICY

14718 (CEA-CONF—9087) Few-nucleon studies with polarized proton and deuteron beams at the Saturne national laboratory (Saclay). Terrien, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie). Jun 1987. 12p. (CEA-DPH-N-S—2467; CONF-8706200—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751841/JAW.

From CEBAF summer workshop; Newport News, VA, USA (22 Jun 1987).

Experiments involving polarized proton or deuteron beams are reported. Based on a few examples of reactions involving a few nucleons, one shows that measurements of spin observables allow deeper physical analysis of the role of the Δ and N/sup */ resonances and of the existence of 3-body forces.

2901 Energy Analysis And Modeling

14719 (LLNL/MISC—4500) Energy-flow diagrams: An LLNL contribution to energy analysis. Borg, I.Y. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 10p. (UCRL—52000-84-5-Rev.). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004393/JAW.

Energy-flow diagrams, developed at the Laboratory, provide a quantitative picture of the supply and consumption of energy resources by various sectors. Many governmental and advisory agencies have adopted this practical device to study current energy use and to aid in understanding energy-use strategies. 7 figs.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 14081, 14180, 14226, 14230, 14231, 14752, 14894, 16101

14720 (CONF-8710212—1-Summ.) Exponential lower bounds for finding Brouwer fixed points. Hirsch, M.D.; Vavasis, S. (California Univ., Berkeley (USA). Dept. of Mathematics; Stanford Univ., CA (USA). Dept. of Computer Science). 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002864/JAW.

From Symposium on the foundation of computer science; Marina Del Rey, CA, USA (12 Oct 1987).

The Brouwer fixed point theorem has become a major tool for modeling economic systems during the 20th century. It was intractable to use the theorem in a computational manner until 1965 when Scarf provided the first practical algorithm for finding a fixed point of a Brouwer map. Scarf's work left open the question of worst-case complexity, although he hypothesized that his algorithm had "typical" behavior of polynomial time in the number of variables of the problem. Here we show that any algorithm for fixed points based on function evaluation (which includes all general purpose fixed-point algorithms) must in the worst case take a number of steps which is exponential both in the number of digits of accuracy and in the number of variables. 12 refs., 4 figs.

14721 (DOE/ER/40300—T1) Economic analysis of payoffs from basic research: Final report. (Stanford Univ., CA (USA)). 16 Dec 1987. Contract FG03-86ER40300. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004131/JAW.

The research project reported has had as its goal the development of a scholarly contribution to the economic analysis of basic research activities, with particular reference to the problems of assessing what economic benefits if any were to be expected for the society at large from continued research in high energy physics. A literature search was undertaken, surveying previous contributions to economic analysis of basic research in general, and applied empirical studies of economic contributions from basic science. A search was also made of recent literature on the development of particle physics research, and assessments of scientific and economic consequences of major projects, including the SSC. Informal meetings and interviews were held between members of the research team and prominent members of the US and international high energy physics research community. Site visits were made to two major high energy physics laboratories, SLAC and Fermilab. Findings are summarized on the applicability of cost-benefit methodologies to basic science research programs. An information-theoretic approach to the economics of basic research and its implications are discussed. (LEW)

14722 (DOE/OR/00033—H1) Energy-related science and engineering personnel outlook, 1987. (Oak Ridge Associated Universities, Inc., TN (USA)). Oct 1987. Contract AC05-76OR00033. 83p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE88004521/JAW.

This report examines the implications of projected energy trends on the labor market for energy-related scientists and engineers for the period 1986 to 1992. The information is intended to assist decision makers, program managers, and others concerned with energy policy and production or with the broader labor market for scientific and engineering personnel in industry, government, and the academic community. The report responds to the mandate contained in the legislation establishing the US Department of Energy, which specifies that DOE provide manpower and education information to assist in the accomplishment of energy R and D and energy supply objectives. 34 figs., 6 tabs.

14723 (NWT—8707) Government of the Northwest Territories submission to the Working Group on Energy Security. (Northwest Territories, Yellowknife (Canada)). Jul 1987. 5p. (MICROLOG—87-05997). Canadian Intergovernmental Conference Secretariat, P.O. Box 488, Station A, Ottawa, Ont., Canada K1n 8V5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The N.W.T. has the potential of producing a significant proportion of Canada's light oil requirements. Major development of N.W.T. oil reserves would make a substantial contribution to Canada's energy security, strengthen Canadian sovereignty in the Arctic, and provide economic benefits to all regions of Canada. The Amauligak field in the Beaufort Sea is capable of producing 27,500 cubic metres (175,000 barrels) per day of high quality light crude oil. Development of this structure would enable reserves from smaller fields in the region to be developed and would provide the impetus for further exploration. Government financial support for specific major energy projects is justified to achieve energy security and self sufficency.

14724 (NZERDC—P107) Domestic heat energy economics: A comparison based on resource costs. (Leyland Watson and Noble, Auckland (New Zealand)). Mar 1986. 112p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900355/JAW.

This study evaluates the cost of providing heat in various forms for use in the domestic sector, based on the resource cost of the fuel and the costs less any taxes or subsidies for other equipment and services. Consequently, the fuel cost figures in $/MJ do not represent the actual cost to the consumer in the marketplace. The emphasis in the study is on the comparison of costs of conversion from fuel to heat, not the comparison of housing styles, standards of living or manufacturers equipment. In each of four regions (Auckland, Taupo, Wellington and Christchurch) various different available fuel types have been evaluated. These areas were selected as being representative of the range of locations and climates in New Zealand. Taupo has been included because of the availability of geothermal power for industrial use. In the domestic sector the energy uses are spaceheating, water heating, and cooking. For each fuel type appliance data, conversion efficiencies and ownership costs have been collected and the cost of conversion to heat evaluated. As the cost of electricity is dependent on the time of the day and season of the year, it has been necessary to determine the pattern of use for each application, and this time dependent aspect is referred to as 'load cycles' in the study.

14725 (PB—88-119854/XAB) Dollar measures of energy production and consumption in the United States, 1972-82. Working paper. Korns, A. (Department of Commerce, Washington, DC (USA). Bureau of Economic Analysis). Jul 1987. 277p. (BEA—88-WP-5). NTIS, PC A13/MF A01.

This report provides, for the first time, comprehensive measures of energy production and consumption consistent with the national income and product accounts (NIPAs). The new set of dollar measures, the energy production and consumption accounts (EPCAs), is designed to facilitate macroanalysis of the relationship between energy aggregates and key aggregates for the entire economy, such as the gross domestic product. The report describes the purposes, the possible applications, and the structure of the EPCAs both as dollar measures of energy production and consumption during 1972-82 and as a statistical innovation in the methods of gathering and analyzing energy data. In its analyses, the report defines and presents components of energy production and consumption, such as personal-consumption expenditures, institutional consumption, change in stocks, imports, exports, and production for direct and indirect use.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 13929, 13965, 13974, 14214, 14230, 14231, 14232, 14341, 14362, 14633, 14637, 14656, 14693, 14732, 14733, 14745, 14848, 15524, 15685, 15698, 15983, 15985, 15989, 15991, 16016, 16037, 16041, 16042, 16044, 16045, 16048, 16061, 16062, 16099, 16100, 16249, 16250

14726 (CONF-871075—24) Considerations in the development of chemical hazard ratings. Edwards, F.K. Jr. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001740/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The goal of this report is to provide a simplified way for individuals to readily recognize the major hazards associated with a material. Statements of hazards should be simple, direct, and concise. While detailed labels do increase the amount of information available, they may also raise levels of concern unnecessarily and reduce reader understanding and retention. The National Fire Protection Association (NFPA) Identification System was used as a basis for the Oak Ridge National Laboratories chemical rating and labeling plan. NFPA uses a well accepted color-keyed symbol system with high recognition value. It identifies the category of hazard by color and the degree of potential hazard by number. This system permits an observer to quickly assess the hazardous nature of a substance. 16 refs.

14727 (CONF-8703206—) Ways and means of keeping air clean in modern industrial societies. 30 years VDI Clean Air Commission. Proceedings. (Verein Deutscher Ingenieure (VDI) - Kommission Reinhaltung der Luft, Duesseldorf (Germany, F.R.)). 1987. 304p. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751688/JAW.

From 30. anniversary of the VDI Commission on air pollution prevention; Duesseldorf, F.R. Germany (17 Mar 1987).

13 lectures were given at the meeting on the subject of immission protection. 10 lectures were documented separately. The subjects cover the possibilities of precautions, process technique questions and measuring harmful substances and damage to the environment.

14728 (CONF-8708184—1) Environmental assessments: Uncertainties in implementation. Hunsaker, D.B. Jr. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002782/JAW.

From Seminar on the role of environmental impact assessment in the decisionmaking process; Heidelberg, F.R. Germany (18 Aug 1987).

A review of the regulations, guidance, statutes, and case law affecting Environmental Assessment (EA) preparation has identified a number of uncertainties that, if clarified, would facilitate EA preparation and National Environmental Policy ACT (NEPA) implementation. Recommendations are made for clarifying the uncertainties regarding EA preparation to help EAs fulfill their intended role in the NEPA process and to thereby facilitate NEPA implementation in general. The CEQ should report annually on the total number of EAs prepared each year in the United States. The current CEQ guidance, as well as requirements for EAs found in other environmental review laws, should be codified into the CEQ regulations. At the same time, existing requirements in the regulations should be collected into a new section dealing exclusively with EAs. The existing regulations should be changed to eliminate the analysis of alternatives in an EA; such as analysis is not usually critical to the decision at hand and is not required by NEPA for EAs resulting in Findings of No Significant Impact (FONSIs). Uncertainties related to identifying significant effects could be addressed by requiring greater public and agency involvement in the EA process before decisions are made. 15 refs.

14729 **(ORNL—6405/R5) Environmental regulatory update table, November 1987.** Langston, M.E.; Sharples, F.E.; Tucker, C.S. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88003699/JAW.

This report provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

2904 Natural Resources

REFER ALSO TO CITATION(S) 14842, 16061

14730 **(EMR—MR35E) Canadian minerals yearbook 1986: review and outlook: centennial edition, 1886-1986.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 26 Jun 1987. vp. (MICROLOG—87-05777). Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, Ont., Canada K1A 0S9; $37.25 CANADA, OTHER COUNTRIES $44.70 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This edition of the Canadian Minerals Yearbook marks the centennial of the first publication of the federal government to record annual statistics on Canada's mineral production. A selection of title pages dating back to 1886 is reproduced, illustrating the various titles and organizations under which the Yearbook was published over the last 100 years. A comparative table of 1886 and 1986 mineral production figures, displaying the dramatic increases in output levels of the Canadian mineral industry, is also presented. This issue reports on the activity of the mineral industry over the past year. The General Review identifies the predominant economic events of 1986 and indicates the major trends in the Canadian economy. It also covers the general developments and overall patterns of the industry during the year. The 55 commodity chapters feature economic developments, uses, price, exports, and production and consumption figures specific to each commodity. The Outlook section under each review provides a forecast of the industry's future position.

14731 **(EMR—MR35F) Canadian Minerals Yearbook, 1986: Overview and Perspective Centennial edition, 1886 to 1986.** (Ministere de l'Energie, des Mines et des Resources, Ottawa, Ontario (Canada)). 26 Jun 1987. vp. (In French). (MICROLOG—87-05778). Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, Ont., Canada K1A 0S9; $37.25 CANADA, OTHER COUNTRIES $44.70 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This edition of the Canadian Minerals Yearbook marks the centennial of the first publication of the federal government to record annual statistics on Canada's mineral production. A selection of title pages dating back to 1886 is reproduced illustrating the various titles and organizations under which the Yearbook was published over the last one hundred years. A comparative table of 1886 and 1986 mineral production figures, displaying the dramatic increases in output levels of the Canadian mineral industry, is also represented. This issue reports on the activity of the mineral industry over the past year. The General Review identifies the predominant economic events of 1986 and indicates the major trends in the Canadian economy. It also covers the general developments and overall patterns of the mineral industry during the year. The 55 commodity chapters feature economic developments, uses, price, exports and production and consumption figures specific to each commodity. The Outlook section under each review provides a forecast of the industry's future position.

14732 **Arctic National Wildlife Refuge, Alaska. Hearing before the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, Part 2, July 22, 1987.** Washington, DC; Government Printing Office (1987). 343p.

This hearing consisted primarily of the testimonies of two witnesses: Roger Herrera, Manager, Exploration and Lands, Standard Oil Production Co.; and Tim Mahoney, Alaska Coaliton, Washington, DC, representing the Sierra Club. The statements of these two, plus questions from the Committee, were to address six issues primarily in the gas and oil production versus environmental debate: (1) availability of water; (2) availability of gravel; (3) disposal of waste and toxic materials; (4) the concentrated caribou calving areas; (5) the environmental record at Prudhoe Bay; and (6) air-quality issues. Sen. Fran H. Murkowski of Alaska, in noting the conflicting statements of the two witnesses noted that many of the environmental questions raised were also raised for Prudhoe Bay; further, the problems are probably not as difficult. Mr. Mahoney foresees, but the solution not as easy as Mr. Herrera, representing the oil interests, foresees.

14733 **Arctic National Wildlife refuge, Alaska. Hearings before the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session on the June 2, 4, 11, and 12, 1987, Part 1.** Washington, DC; Government Printing Office (1987). 983p.

In these four days of hearings, testimonies or statements are included from 28 federal and state officials, bird and wildlife officials, conservation and environmental officials, and representatives from the US petroleum industry. The Alaska National Interest Lands Conservation Act of 1980, Section 1002, directed the Secretary of the Interior to study: (1) the oil and gas potential of the ANWR Coastal Plain; (2) the wildlife and other surface resource values of the area; and (3) the area's wilderness potential. Since the Coastal Plain is located just 65 miles from Prudhoe Bay, which now provides more than 20% of US domestic crude oil production, the competing values of oil vs surface resources must be weight deliberately, in spite of the Secretary's recommendation that the entire Coastal Plain be made available for oil and gas leasing. Needless to say, many strongly disagree with the Secretary, and Chairman Sen. J. Bennett Johnston assures that there will be not rush to judgment on this very controversial issue.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 14722, 14756, 15530, 15671, 16101

14734 **(ANL-TTC—86-1) Towards a structured methodology for evaluating inventions for patent protection.** Ehrman, C.M. (Argonne National Lab., IL (USA). Technology Transfer Center). [1987]. Contract W-31109-ENG-38. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003551/JAW.

Many national, federally funded laboratories face the dilemma: Which inventions should be patented? If patents were available gratis, all inventions would be patented. Patent costs are the cause of the dilemma and are viewed as a constraint that limits the number of inventions that can be patented. We suggest a different problem structure. The current goal in technology transfer is to maximize the number of firms adopting new technology. The proposed research agenda is: Which inventions have the highest likelihood of adoption given an appropriate marketing effort to develop need-awareness among potential users? We suggest determinance scores as a means of evaluating potential success. Reibstein and Moriarty (1981) used this approach in an industrial setting. The objective of the technology transfer center is to deliver business clients to inventors. 3 refs., 7 figs., 6 tabs.

14735 **(BNL—52100-Rev.) Brookhaven National Laboratory five year technology transfer program plan.** Marcuse, W. (Brookhaven National Lab., Upton, NY (USA)). Sep 1987. Contract AC02-76CH00016. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004490/JAW.

This paper describes the technology transfer program at Brookhaven National Laboratory.

14736 **(DOE/OR/00033—T381) The role of three university-based consortia in energy-related science and education.** (Associated Western Universities, Inc., Salt Lake City, UT (USA); Northwest Coll. and Univ. Association for Science, Richland, WA (USA); Oak Ridge Associated Universities, Inc., TN (USA)). Oct 1987. Contract AC05-76OR00033. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004092/JAW.

This report describes how 3 groups of universities promote study in energy related scientific fields. 6 refs., 4 figs.

14737 **(DOE/OR/21400—T324) Written testimony before the Subcommittee on Defense Industry and Technology.** Postma, H. (Oak Ridge National Lab., TN (USA)). 7 Nov 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003136/JAW.

In the past, DOE's national laboratories have played an extraordinary role in the development of the national security and technological competitiveness of this country. They have the proven ability to accommodate rapidly to change, to take on new missions, and to find innovative and crucial solutions. Yet, constraints imposed on these laboratories have caused them to be operated with less than optimum efficiency. The author believes that the removal of the 20% outside funding limit imposed by DOE, improvement of the technology transfer options, and allowing flexibility in the use of funds within the laboratories will enable these national laboratories to more fully use their vast scientific technological resources to help the nation meet the global competitive challenge and to be national laboratories in the complete sense of the word. 2 figs.

14738 **(LA-UR—87-4010) Innovative arrangements for industry/DOE laboratory collaboration in high temperature superconductivity.** Williams, J.M. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 8p. (CONF-880212—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004320/JAW.

From 15. annual energy technology conference and exposition; Washington, DC, USA (17 Feb 1988).

This report discusses some of the reasons it is necessary for universities, the Department of Energy, and industry to cooperate in developing new high temperature superconductors. (JDH)

14739 **(LBL-PUB—618) Industry and Lawrence Berkeley Laboratory: An important partnership.** (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004037/JAW.

As a national laboratory, the Lawrence Berkeley Laboratory (LBL) has an obligation to see that its research results and resources are made available to the public as rapidly and efficiently as possible. Private industry, through utilization and commercialization of laboratory technology, provides an essential function in making the practical applications of scientific advances available to the public. To help make the transfer of technology from Lawrence Berkeley Laboratory to industry effective, this publication summarizes the ways that industrial researchers interact with LBL's scientists. Included are (1) a brief introduction to LBL with suggestions on how to identify areas of research interest, (2) ways of working with LBL to utilize LBL facilities and expertise, (3) a description of research programs and contact points in the Applied Science Division and the Center for Advanced Materials, which have many interactions with industry, and (4) a description of LBL resources for initiating and maintaining private sector/LBL interactions. While specifically addressed to researchers and managers in private industry, the procedures described here are also utilized by others such as universities, state and local governments, and federal agencies.

14740 **(LBL-PUB—633) Center for science and engineering education undergraduate programs.** (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 134p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88003866/JAW.

As part of a sustained commitment to the education and training of future scientific researchers, the Department of Energy (DOE) and Lawrence Berkeley Laboratory (LBL) support a variety of activities directed at the development of undergraduate students. Two undergraduate programs, the Laboratory Co-op Program and the Science & Engineering Research Semester, comprise the core of the current Lawrence Berkeley Laboratory Center for Science and Engineering Education activity in undergraduate student education. These programs provide opportunities for top undergraduate students from colleges and universities throughout the nation to work in advanced research projects carried out primarily for the Department of Energy. Undergraduate programs are designed to attract participants who plan to pursue careers in science, engineering and education fields relevant to future national science needs. The primary goal is to educate and train scientists and engineers to meet the nation's future manpower requirements in the energy and general sciences. This volume contains the final reports of the students from the 1987 program.

14741 **(ORAU—87/J-100) Oak Ridge Associated Universities Technology Transfer Program: Annual report, FY 1987.** (Oak Ridge Associated Universities, Inc., TN (USA)). Nov 1987. Contract AC05-76OR00033. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003359/JAW.

Several of ORAU's FY87 technology transfer accomplishments have resulted in improvements in the University Isotope Separator at Oak Ridge (UNISOR), a DOE scientific user facility. UNISOR is a cooperative venture of nine universities, ORAU, Oak Ridge National Laboratory, and the state of Tennessee. Three application assessment records were filed for UNISOR, and a patent waiver was granted for a low-level particle beam monitor and current meter. Some activities in the Medical and Health Sciences Division's biochemistry and nuclear medicine programs have resulted in products with commercialization potential. DOE has granted ORAU a patent waiver for a myocardial imaging agent, and a waiver petition for an antihypertensive neutral lipid has been filed and is pending. In addition, ORAU has signed an agreement with a small business to develop and demonstrate the production capability of a small cyclotron. ORAU will work with industry to explore options for further development and commercialization of all three products.

14742 **(ORNL/M—184) Users facilities and technology to support aerospace industries.** Trauger, D.B. (comp.). (Oak Ridge National Lab., TN (USA)). 1 Oct 1986. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004667/JAW.

The listings and brief essays describe capabilities and programs primarily at ORNL and ORGDP that can support the essential needs of the aerospace industries. Technical reports, consulting, the use of facilities, and, in some cases, directly supported work can be undertaken. Licenses to some patented technologies may be available directly from Martin Marietta Energy Systems, Inc., on an exclusive or nonexclusive basis. ORNL is presently in consultation with and provides support to several companies and government agencies involved in the aerospace industries. These include Boeing, Lockheed, Grumman, McDonnell Douglas, Martin Marietta Corporation, Rockwell International, the Department of the Air Force, and the National Aeronautics and Space Administration. Access to these services is available through the Martin Marietta Energy Systems, Inc., Office of Technology Applications.

14743 **(ORNL/PPA—87/2) Oak Ridge National Laboratory Institional Plan, FY 1988-FY 1993.** (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88004776/JAW.

This paper presents a review of research programs at the Oak Ridge National Laboratory. Sources of funds an projected areas of interest are described. 16 figs., 40 tabs.

14744 **(UCRL—15967) A study of technology transfer arrangements for national laboratories.** Dorf, R.C.; Worthington, K.K.F. (Lawrence Livermore National Lab., CA (USA)). 25 Aug 1987. Contract W-7405-ENG-48. 103p. NTIS, PC A06. Order Number DE88005423/JAW.

The transfer of technology to industrial partners and users is a complex task. The interactions between federal laboratories and industry and the market knowledge and ability to assess the needs of business users are beyond the charter of a federal laboratory. Therefore, new organizational mechanisms are required in order to obtain full commercial value from the laboratories' efforts. This paper will analyze cases of new ventures emerging from technology developed within federal laboratories. Seven models will be identified for technology transfer. These are the Information Dissemination Model, the Licensing Model, the Venture Capital Model, the Large Company-Joint Venture Model, the Incubator-Science Park Model, the Ferret Model, and the Agriculture Extension Model. Out of 13 laboratories, a Lawrence Livermore National Laboratory Partnership will be identified as having the greatest potential for successful implementation. The arrangement is a proposed consortium of the Lawrence Livermore National Laboratory, the University of California, venture capitalists, industrial firms, and federal and state agencies. 10 refs., 2 figs., 4 tabs.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 13965, 14214, 14226, 14230, 14231, 14232, 14311, 14312, 14313, 14314, 14340, 14341, 14584, 14585, 14586, 14759, 14768, 15951

14745 **(BNL—52075) Level of evidence for reasonable assurance guides to prediction.** Schweitzer, D.G.; Sastre, C. (Brookhaven National Lab., Upton, NY (USA)). Apr 1987. Contract AC02-76CH00016. 18p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005242/JAW.

Over the past years, the DOE Contractors have produced a great deal of work that has been extensively reviewed and criticized by the Nuclear Regulatory Commission (NRC), the Materials Review Board (MRB) of the DOE, the Advisory Committee on Reactor Safeguards (ACRS), and the technical support group at Brookhaven National Laboratory (BNL). Common aspects of the reviews and criticisms have provided information on the level of evidence required by the scientific community to defend performance claims. Important indicators of the type of evidence that the NRC will require for favorable decisions of reasonable assurance also can be obtained from 10 CFR 60 and its rationale, from NRC guides and Technical Position papers, from past reviews of the DOE programs by NRC Contractors, and from the use of reasonable assurance by the NRC in its 1984 Waste Confidence Decision. This report describes general concepts related to the acceptability and unacceptability of the level of evidence needed to defend claims with reasonable assurance. The concepts were formulated on the basis of analyses of the NRC position papers, and of common aspects of the reviews and criticisms dealing with compliance demonstration.

14746 **(DOE/NE—0085) Atoms to electricity.** (USDOE Assistant Secretary for Nuclear Energy, Washington, DC. Office of Program Support). Nov 1987. 90p. OSTI, PO Bx 62, Oak Ridge, TN 37831. Order Number TI88005249/JAW.

This booklet explains the basic technology of nuclear fission power reactors, the nuclear fuel cycle and the role of nuclear energy as one of the domestic energy resources being developed to help meet our national energy demand. Nuclear power accounted for over 16 percent of the US electric energy supply in 1986 and was second only to coal as a source of our electric power. In the 1990s, nuclear energy is expected to provide almost 20 percent of the Nation's electricity. 38 figs., 5 tabs.

14747 **(ESC—26) Experience of energy risks. A national investigation of suppositions, attitudes, standard specifications and behaviour in regard of the generation of electricity from coal, uranium and wind.** Midden, C.J.H.; Daamen, D.D.L.; Verplanken, B. (Netherlands Energy Research Foundation, Petten. Energy Study Centre). Sep 1983. 435p. (In Dutch). Library KNAW, P.O. Box 19121, 1000 GC Amsterdam, The Netherlands.

In this study attention has been paid to the following questions: What is the distribution of attitudes towards the widespread application of coal, uranium and wind; How can these attitudes be explained with (clusters of) beliefs about the energy systems; How are behavioral intentions determined by attitudes and normative influences; What is the relevance of factors like involvement with the subject, the perceived personal effectivity to influence collective decisions to use coal, uranium or wind on a large scale, the level of information about these energy systems, the different ways to obtain this information, the degree to which one has a vivid and detailed image of the possible negative consequences of the use of these energy systems; Are there people who feel threatened by the use of these energy systems. Which ways of coping with this threat can be identified; What are the preferences and expectations with respect to the use of energy options in the future; Are there differences in risk perception between various population-categories which differ with respect to sex, age, education, income, religion, political conviction, distance between dwelling place and the nearest electrical power station. The report concludes with an elaborate discussion of the results and suggestions for energy policy and research. 72 references, 54 figures, 116 tables.

14748 **(INIS-GB—88) Getting the balance right. An alternative look at the need for nuclear energy.** (Nuclear Electricity Information Group, London (UK)). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750951/JAW.

This 8 page leaflet is published by the Nuclear Electricity Information Group (NEIG) which is made up of eight different bodies working within the nuclear industry. It aims to present a balanced outline of the facts needed to form an opinion about energy policy in the UK. It looks at the price of electricity, other sources of electricity, (oil and coal, solar power, wind power, water power), safety in the nuclear industry, nuclear waste disposal and risks from radiation. The NEIG is in favour of a balanced energy programme with nuclear energy being only a part of the overall scheme. (U.K.).

14749 **(INIS-mf—11000) Study of the viability of nuclear power generation in Uruguay. Vol. 1, 2.** (Comision Nacional de Energia Atomica, Montevideo (Uruguay)). 1985. 381p. (In Spanish). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88700877/JAW.

This study was carried out to take into consideration the Nuclear Power option in Uruguay. Though Nuclear Power could be useful since year 2000, this does not mean a Nuclear Power station should be necessarily built. In the accomplishment of the nuclear option, next stage to take into account is the comparison of the following: a) 300/600 Mw Nuclear Power station owned by Uruguay; b) 600/1200 Mw Nuclear Power station shared amongst Uruguay and neighboring countries. National energy needs were studied, including previous electric demand studies made by international consultants. National direct resources and support infrastructure were also analysed. Oil, gas, coal and hydraulic options were compared to the nuclear option.

14750 **(INIS-mf—11096) Nuclear Power Day '86. Collection of papers.** (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 9 Dec 1986. vp. (In Czech). (CONF-8610377—). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780047/JAW.

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

Individual papers were abstracted separately for the data base.

14751 **(NUREG—0325-Rev.11) US Nuclear Regulatory Commission functional organization charts.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration and Resources Management). 1 Jan 1988. 55p. NTIS, PC A04 - GPO. Order Number TI88900284/JAW.

This document provides functional organization charts for all NRC Offices and Regions, and their components.

14752 **(NUREG—1290) Differing professional opinions: 1987 Special Review Panel.** (Nuclear Regulatory Commission, Washington, DC (USA)). Nov 1987. 171p. NTIS, PC A08/MF A01 - GPO. Order Number TI88900248/JAW.

In mid-1987, the Executive Director for Operations of the US Nuclear Regulatory Commission appointed a Special Review Panel to review the existing NRC policy for expressing differing professional views and to recommend possible improvements to the policy, if warranted. Through its own efforts and those of three subpanels and three consultants, the Panel developed recommendations for changes and improvements in five major areas. This report presents those recommendations, along with a detailed explanation of the Panel's findings, copies of the reports of the subpanels and consultants, and the results of a survey of NRC non-clerical employees on the issue.

14753 **(UFRJ-COPPE-PEN—127) Energy decisions: technocracy x democracy.** Borges, J.C. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). Jun 1984. 13p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700283/JAW.

In all the countries of the world, official energy policies and programs are criticized by experts from the academic community and by the population at large. It is quite normal that people censure their government, but under the cloak of scientific arguments, one can usually find political objectives. In this paper, we try to analyse parameters which are an influence in this power game: up to what point can or should technocrats decide in the name of the people. When and now can or should the people demonstrate their preferences. As this is a vast and polemic theme, and ir order that some concrete conclusion could be drawn, we tried to concentrate our analysis on a specific case: the Brazilian decision to use nuclear energy.

14754 **Nuclear power options viability - Oak Ridge National Laboratory's study.** Gat, U.; Trauger, D.B.; White, J.D. (Oak Ridge National Lab., Oak Ridge, TN). pp 206-209 of Emerging nuclear energy systems. Velarde, G.; Minguez, E. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-860601—). Contract AC05-84OR21400.

From 4. international conference on emerging nuclear energy systems; Madrid, Spain (30 Jun 1986).

Seven criteria, augmented by desired characteristics, were established to assess the viability of nuclear reactors for the timeframe beginning at 2005 for the United States. Earlier nuclear power needs will be filled by LWRs. Several advanced concepts were selected, based on three ground rules, and assessed. It was concluded that there are several acceptable and viable concepts.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 14116, 14872

14755 **(NEDO-P—8617) Feasibility study for introduction of new energy in urban redevelopment.** (New Energy Development Organization, Tokyo (Japan)). Mar 1987. 205p. (In Japanese). NTIS (US Sales Only), PC A10. Order Number DE88770049/JAW.

As part of the efforts to promote regional development, public organizations and private firms have been engaged in redevelopment of large city areas and basic development of smaller city areas. As a result, the energy consumption density is expected to increase greatly in these development areas. It is considered at the same time that the introduction of new energy may be feasible in the areas. A survey was carried out in Kanagawa Science Park, which was selected as a model area. Some power systems are examined with respect to their suitability as the power source for the cogeneration system, which is planned to be introduced. Analysis of the suitability for operation for 24 hours a day, adaptability to varying damands, fuel characteristics and efficiency per unit area has led to the conclusion that the use of a gas turbine engine with an output of about 20,000 h.p. will be effective. A study on costs indicates that for a gas turbine cogeneration system, the use of kerosene, instead of town gas, as the main fuel may be more economical. (49 figs, 50 tabs)

14756 **(NEI-DK—54) Establishment of a bilateral agreement between USA and Denmark regarding district heating.** (Cowiconsult Raadgivende Ingenioerer A/S, Virum (Denmark); Harry og Mogens Larsen A/S, Odense (Denmark)). Feb 1987. 98p. (In Danish and English). NTIS (US Sales Only), PC A05. Order Number DE88751085/JAW.

In December 1986 a Danish delegation visited US Department of Energy and Brookhaven National Laboratory in order to discuss and establish a cooperation between USA and Denmark regarding energy research related to district heating. The Danish Ministry of Energy is interested in a formal cooperation because of the possibility of increasing Danish exports and also because such a cooperation may have a positive effect on the Danish district heating research and development. The report includes the minutes from the meetings with USDOE and BNL, conclusions and recommendations, and a tentative draft of memo of understanding. Also the report includes previous appendices on: correspondence, list of district heating research projects financed by the Danish Ministry of Energy 1980-1986, program plan for BNL Community Energy System, research program summary of the USDOE Community Systems Program, extracts from BNL report 51999 District heating and cooling market potential and penetration methodology, and EPRI - Customer preference and behavior project, project overview - draft. (LN).

2910 Conservation

REFER ALSO TO CITATION(S) 14454, 14723, 14815, 14841, 14842, 14878

14757 (NEI-NO—16, pp 15) **Energy conservation basis. Deposit gas and bioenergy in energy conservation context.** Solberg, E. (Norges Vassdrags- og Elektrisitetsvesen, Oslo. Elektrisitetsilsynet). 9 Dec 1986. (In Norwegian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751113/JAW. (CONF-8612116—).

From Seminar on utilization of energy and biogas from waste deposits; Sandefjord, Norway (9 Dec 1986).

The lecture shows how different energy projects may be compared and evaluates the usefulness of the projects in money based on costs of the alternatives. The presented method may be used for all energy projects at all levels in the energy system including measures for reducing the consumer consumption. If the energy tariffs picture the macro-economic costs for developing new power, the use of this method helps to promote and stimulate a rational energy consumption in the society. The consumer is always interested in meeting his demands for useful energy as reasonable as possible. By choosing an energy carrier composition which reduces the energy costs to a minimum and reducing energy loss by energy conservation measures, this may be obtained. 1 table, 7 drawings.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 14080, 14112, 14113, 14114, 14723, 14755, 14766

14758 (INIS-mf—11095, pp 24-49) **Czechoslovak energy balance and its prospectives.** Cibula, M. (Statni Planovaci Komise, Prague, Czechoslovakia). 9 Dec 1986. (In Czech). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88701081/JAW. (CONF-8610377—).

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

Currently, Czechoslovakia imports 98.5% of oil consumed, 93% of natural gas, 9% of coal and 5.2% of electric power. On the other hand, it exports 9% of the domestic production of coal, mainly of bituminous coking coal and of coke. In contrast to the world balance in which the share of coal in power consumption amounts to about 20%, in Czechoslovakia the ratio was 60% to the end of the '70's. Since the beginning of the '70's, nuclear power has become the decisive power source for covering the increased power consumption, and in future years it should cover the entire growth of electric power consumption. In 1995, more electric power should be produced by nuclear plants than by coal-fired plants. Structural changes are described in detail of power sources as are the main trends of their rational utilization. The questions are also discussed of social and economic effectiveness of the orientation to nuclear power in the Czechoslovak situation. (Z.M.). 1 fig., 7 tabs.

14759 **(NP—8751664) Iran - energy situation 1985/1986.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Dec 1986. 14p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751664/JAW.

The brochure provides a brief overview of the situation regarding the energy sources petroleum, natural gas, coal, nuclear energy, uranium, and electricity in Iran. Since reliable figures are not available or not accessible, this report is based largely on estimates from statements by experts and representatives of economy as well as from press publications.

14760 **(STEV—1985-R4) Demand for commercial energy in developing countries.** O'Keefe, P. (Statens Energiverk, Stockholm (Sweden)). Oct 1985. 82p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751134/JAW.

This paper considers demand for commercial energy in developing countries. In particular, it seeks to understand the nature of the demand for oil, set against developments in other commercial fuels, insofar as the demand will impact on the world oil market. To do this, the paper seeks to answer four broad questions, namely, what is the current and projected demand in developing countries? Are there substantial variations amongst developing countries in projected demand? Do different price structures for hydrocarbons significantly alter energy opportunities? What implications does the demand for commercial energy in developing countries have for developed countries? With 29 refs.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 13965, 14081, 14082, 14083, 14096, 14122, 14232, 14313, 14314, 14341, 14588, 14725, 14728, 14729, 14745, 14752, 15698, 15983, 15985, 15989, 15991, 16041, 16042, 16043, 16044, 16045, 16061, 16249

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 14079, 14080, 14081, 14082, 14083, 14096, 14096, 14112, 14113, 14114, 14116, 14117, 14120, 14120, 14122, 14759

14761 **(SEM/PNG—87) [Saskatchewan] Reservoir annual, 1985.** (Saskatchewan Dept. of Energy and Mines, Regina (Canada). Petroleum and Natural Gas Div.). [1987]. vp. (MICROLOG—87-05936). Saskatchewan. Saskatchewan Energy and Mines, 1914 Hamilton St., Regina, Sask., Canada S4P 4V4; $60.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The 1985 Reservoir Annual is published by Saskatchewan Energy and Mines to provide current statistical information regarding performance and reservoir parameters of Saskatchewan oil and gas pools. The 1985 edition is subdivided into 11 sections, each dealing with a specific type of reservoir data. Included are maps showing oil and gas pools, production and disposition areas, well spacing areas, and other related information. Also provided are reservoir data and reserves for all provincial oil and gas pools broken down by unit and non-unit areas. In addition, a listing of oil and gas units and enhanced recovery projects provides such information as operator, producing zone, number of active wells, and project data such as pattern type, commencement date, and injection rates. Well spacing, depletion mechanism, capable and active wellcounts, and average well production rates for Saskatchewan oil and gas pools are specified. Illustrations of typical producing well logs, pool pressure data, Maximum Permissive Rate factors, gas plant performance plots, and formation water resistivity measurements are given. All reserve, production, pool boundary, and well spacing information contained in this publication is as of December 31, 1985, unless otherwise noted.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 14376, 14489

2960 Electric Power

REFER ALSO TO CITATION(S) 14385, 14759

14762 **(CONF-871256—1) Integrated resource planning: A view from the trenches.** Hirst, E.; Knutsen, C. (Oak Ridge National Lab., TN (USA); Puget Sound Power and Light Co., Bellevue, WA (USA)). Dec 1987. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004334/JAW.

From Energy Power Research Institute conference; New Orleans, LA, USA (1 Dec 1987).

The planning process (as distinct from the plan itself) is a critical, and often neglected, element of utility planning. Regardless of whether the planning is traditional, least-cost, integrated resource, or integrated value-based; cooperation, communication and consensus among the utility planning staff are vital. In early 1986, Puget Power established a Demand and Resource Evaluation (DARE) program, intended to improve its internal planning process and prepare a long-term integrated resource plan. This paper describes DARE activities during its initial 18-month cycle. Key lessons learned from DARE include: the need for internal cooperation, the amount of time needed to establish a viable planning activity, the required commitment to planning from top management, the balance between analysis and experience, the value of public participation, and the necessity of developing realistic goals for the initial plan. 8 refs., 3 figs., 1 tab.

14763 **(DOE/BP—903) 1987 Pacific Northwest Loads and Resources (Whitebook): Executive summary.** (USDOE Bonneville Power Administration, Portland, OR. Div. of Power Resources Planning). Dec 1987. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005295/JAW.

The BPA Pacific Northwest Loads and Resources Study establishes a set of planning bases to assure its customers an adequate, cost-effective, and environmentally sound supply of electricity. BPA's forecasted loads are subtracted from available resources to determine whether the region is in surplus or deficit. This is calculated for three scenarios: high, medium, and low load growth. If the resources are greater than the loads in any particular year or month, surplus energy and/or capacity will be available for sale. Conversely, if the loads exceed the available resources, additional conservation, contract purchases, or generating resources will be needed to meet regional requirements. 19 figs., 2 tabs.

14764 **(DOE/EIA—0226(87/10)) Electric power monthly, October 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 15 Jan 1988. 49p. NTIS, PC A03/MF A01 - GPO; 1; GPO Dep. Order Number DE88005263/JAW.

Total net generation by electric utilities in the United States for October 1987 was 203,007 gigawatthours, 3% higher than the amount reported a year ago. Rising petroleum prices resulted in a decline in electricity generation from petroleum-fired units at electric utilities. Petroleum-fired plants produced only 6821 gigawatthours for October 1987, the low for the year, 31% lower than the amount reported for October 1986. During October 1987, electricity generation from petroleum was less than 4% of the total US net

generation. Hydroelectric generation for October 1987 represented 9% of the total US net generation. Net generation from hydroelectric units produced 17,952 gigawatthours, 16% below the amount reported a year ago. During October 1987, coal-fired plants produced 58% of the total US net generation, compared with 55% during October 1986. Electric utilities also reported a large increase in coal inventories at the end of October 1987 - more than 9 million tons above the level reported at the end of September 1987. Nuclear-powered net generation produced 36,492 gigawatthours during October 1987, slightly more than what was reported for October 1986, but 8% less than the September 1987 level. Nuclear-powered net generation declined during October 1987 because 35 units generated below 25% of capacity.

14765 (DOE/EIA—0397(87/3Q)) Electric power quarterly, July-September 1987. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 22 Jan 1988. 340p. NTIS, PC A15/MF A01 - GPO; 1; GPO Dep. Order Number DE88005353/JAW.

The EPQ presents monthly summaries of electric utility statistics at the national, divisional, state, company, and plant levels on the following subjects: quantity of fuel, cost of fuel, quality of fuel, net generation, fuel consumption, fuel stocks. In addition, the EPQ presents a quarterly summary of reported major disturbances and unusual occurrences. These data are collected on the Form IE-417R. Every electric utility engaged in the generation, transmission, or distribution of electric energy must file a report with DOE if it experiences a major power system emergency.

14766 (EFI-TR—3378) Future adjustment between supply and demand in the Norwegian electric power supply system. Johannesen, A.; Botnen, O.J.; Reinertsen, T. (Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)). May 1987. 98p. (In Norwegian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751197/JAW.

The adjustment between supply and demand in the Norwegian electric power system towards the year 2010 has been analyzed. The analysis is based on two alternative main premises: (1) Within given bounds, it is permitted to develop that category of power production which is cheapest. (2) A possible further development is to be done by production in a specified category. Gas power plants are to be considered both as supplementary power plants as well as base load plants in the power production alternatives. 7 refs., 36 figs., 22 tabs.

14767 (EFI-TR—3412) Production planning. Philosophy and model tools. Green, T.; Haugstad, A.; Nyland, S.; von Hirsch, R.; Hornnes, K.S.; Broenner; O.; Reinertsen, T.; Olaussen, E.; Reitan, R.; Johannesen, A. (Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)). Mar 1987. 140p. (In Norwegian). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751226/JAW.

The report gives an extensive survey of methods and models for electric energy production planning. It deals with decision models, prognose models and models for consequence analysis, and gives some examples of applications. 13 refs., 74 figs., 11 tabs.

14768 (INIS-GB—79) Electricity supply industry in England and Wales. Medium term development plan 1986-1993. (Electricity Council, London (UK)). Sep 1986. 54p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks, LS23 7BQ. .

The main objective of the Electricity Supply Industry in England and Wales is to develop and maintain electricity supplies to meet customers' needs as cheaply as possible. Over the medium term, 1986 - 1993, the goal is to reduce the real average price per kWh sold, whilst maintaining high standards of service and meeting financial obligations. The strategy set out comprises reducing controllable costs per kWh sold to 1992/3, pursuing a vigorous and selective marketing strategy so that an expected sales increase of 10% is achieved, securing a long term supply of coal at minimum cost by developing the commercial relationship with British Coal, increasing the proportion of electrical energy supplied by nuclear energy to 25% by 1992/3 and being environmentally concerned. The introduction outlines the medium term business, energy and economic environment, financial targets and price prospects. Plans to support the strategy outlined are presented. Each section sets out the objectives and the plans to achieve these. The strategy for new power stations is to develop fossil-fueled and nuclear as well as to develop alternative technologies.

14769 (INIS-XN—73) Royal Decree 441/1986 of 28 February 1986 on the establishment of new electricity tariffs. (International Atomic Energy Agency, Vienna (Austria)). 1 Mar 1986. 2p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700668/JAW.

Published in Boletin Oficial del Estado.

This Decree raises electricity tariffs and prescribes the use to be made of the funds obtained from the sale of electricity: electrical/technical R and D, constitution of uranium stocks and work on the terminal part of the nuclear fuel cycle. (NEA).

14770 (LBL—23906) Designing PURPA [Public Utilities Regulatory Act] power purchase auctions: Theory and practice. Rothkopf, M.H.; Kahn, E.P.; Teisberg, T.J.; Eto, J.; Nataf, J.M. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 155p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88004899/JAW.

The Public Utilities Regulatory Act (PURPA) requires there to be procedures for electric utilities to buy electric power from qualifying cogenerators and small power producers (QFs) at rates up to "avoided cost." This has led to price-posting procedures at prices calculated as the utility's marginal cost. Unexpectedly large sales at these prices and slow adjustment to falling energy cost are partially responsible for payments to QFs in excess of the utility's true avoided cost. Using competitive bidding instead of posted prices has been proposed as a way to avoid this outcome. This report reviews bidding theory and explores four issues that arise in deisigning auction systems for the purchase of power from QFs under PURPA. 77 refs., 6 figs., 15 tabs.

14771 (NEI-FI—34) New possibilities of electricity measuring. Rantala, E.; Rantala, K. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Jun 1987. 62p. (In Finnish). NTIS (US Sales Only), PC A04. Order Number DE88751174/JAW.

The objective of this pro-report was to find out the present market situation of statical electricenergymeters and the possibilities which electronic has especially within the area of subsequent electric energy measurement. In addition to the meters now found on the market, the report sketches also their use as means for changing attitudes in regard to energy consumption. The different participants of electricity consumption have also taken view of trends in the future. The report gives also hints of the new trends in product development. It seems likely, that meters developed only for the energy measurement have difficulties in gaining market from the mechanical meters inside of a short time span. By means of electronics it is however possible to construct in one single device many different functions (measurement, regulation, control, invoicing knowledge etc.), which makes the significance of the device to increase. Also the price per function gets smaller. The consumers have got to their use meters, which in addition to measurement of electricity consumption also tell how much the electricity consumed pays. Reading the meter has no use, if it does not lead to actions, which make the use of electricity more effective and reasonable. There arises the importance of attitudinal education in the world of energy consumption. This area demans more research, after which it is possible to produce such kind of material which would help people to see supervision of electricity consumption as sensible and useful. Wider goals should be set on the product developement in measurement, control and regulation. We should get loose from the product level and set the demans on the final level, which in this case could be for example housing comfortness, increasing of consumption knowledge, economy, easy reading, versatility etc.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 14079, 14724, 14725, 14836

14772 (NEI-NO—29) National energy data report. Norway 1981. (World Energy Conference, Oslo (Norway). Norwegian National Committee). 1983. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751204/JAW.

The report discusses general features of the energy economy in Norway. In the opinion of the Government energy prices are a particularly important and effective means of influencing the trend in the consumption of energy and distribution between different sources of energy. The preliminary energy supply and final energy demand by sources and sectors are presented and discussed. 11 drawings, 7 tables.

14773 (UCID—18991-86) California energy flow in 1986. Borg, I.Y.; Briggs, C.K. (Lawrence Livermore National Lab., CA (USA)). 20 Nov 1987. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004371/JAW.

Although California is the fourth largest oil producing state in the nation, 45% of the state's energy supply is from out-of-state sources. Imported oil and natural gas are the principal fuels used. The only coal used within state borders is a small amount of coking coal. Total energy demand in California fell 1.5% in 1986 in part due to a mild winter that led to decreased heating requirements in the residential, commercial, and to a lesser extent, the industrial end-use sectors. The decline in industrial energy consumption paralleled the decline registered in the US as a whole, but was more marked in California. As industrial activity was robust by all criteria, the decline relates to increased efficiencies as well as the increasing importance of service industries and other less energy intensive components in the sector. Consumption of fuels for transportation increased to an all time high; the growth in 1986 exceeded the estimated population increase over the same period. Cogeneration and self-generation of electrical power increased substantially and continued to displace utility generated power which has posed problems for the utilities and regulatory agencies alike. Expected growth in both sources, as well as in alternative sources of power in the state, such as geothermal and windpower, promises to produce an electrical capacity suplus within a few years. 27 refs., 4 figs., 8 tabs.

14774 (VTT-TIED—709) Energy Consumption of cities and location of activities. Kivilaakso, E. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). May 1987. 116p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751175/JAW.

The energy consumption of the future city structures depends, for instance, on decisions made today in city planning. The aim of this study is to investigate in what way these decisions affect the energy consumption. The results of this study are based on calculations of different theoretical and real urban structures. Some references to literature are also included. The study on the energy balance of cities outlines the production and consumption frames of energy. The differences in transportation are studied using theoretical city models. The comparison of residential areas is based on the real locations of existing suburbs in the Helsinki metropolitan area. The theoretical model calculations show that the most energy efficient city sizes are those having no more than 100000 inhabitants and a rather high density. Integration and homogenic distribution of activities decrease the demand of energy. In small towns the concentration of working and services in city centres decreases the energy consumption as well. The concentration of activities on the outskirts of cities increases the transportation and average travel distances. The advantageousness of structures having mixed activities increases with the city size. Independent subareas decrease the need for transportation. In large urban areas of metropolitan character the proportion of transportation becomes dominant in energy consumption. The distances and the need for cross-sectoral transportation increase, promoting additional use of private cars. The comparison between actual new residential locations in the Helsinki metropolitan area shows that the cost differences can be quite remarkable. The most expensive location (Latokasti) amounts to an additional annual cost of about FIM 2500/inhabitant compared with the least expensive (Ruoholahti). THis means extra costs of about FIM 13 million (USD 4 mill.) per year in a typical neighbourhood unit of about 5000 inhabitants. Half of this are energy costs.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 14381, 14452, 14489

14775 (BMFT-FB-T—86-225) Systems for exploitation of solar, wind and biogas energy in the People's Republic of China. Phase II. Subproject supporting research. Final report. Jaeckel, G.; Morovic, T. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung). Dec 1986. 78p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751656/JAW.

The work was carried out in connection with the associated research section of the German-Chinese solar energy pilot scheme for the exploitation of renewable energy sources in supplying rural areas. It consisted in cooperation and advisory services in the development of the general concept, the pre-planning, and the planning stages, associated research, and a training and educational programme. The associated research comprises measuring programmes I and II for the five model houses and the collector hot water and heating system, evaluation of the measurements, and the concept for technical and viability assessment of all systems and components. The planning work and the training programme were successfully completed. The Chinese partner adopted the German suggestions extensively. A joiners' workshop was set up for the manufacture of passive solar house components. The associated research will be completed in Phase III of the scheme. So far the measuring arrangements have been set up and test measurements carried out. The Chinese partner was successfully initiated into the servicing of the instruments and the evaluation of the measurements. The concept for the technical and viability assessment was accepted by the Chinese partner. With 8 refs., 6 tabs., 31 figs.

14776 (NEI-NO—16, pp 8) **Landfill gas. A rising star.** Richards, K.M. (UKAEA Energy Efficiency Office, Harwell UK). 9 Dec 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751113/JAW. (CONF-8612116—).

From Seminar on utilization of energy and biogas from waste deposits; Sandefjord, Norway (9 Dec 1986).

The lecture describes briefly the landfill gas research and consumption development in the UK in the 1980ies and predicts a likely development profile into the next century. A short survey of the quantity of gas available, the likely production of gas from an average landfill, its chemical composition and the construction of an average producing plant is given. Various uses of the gas are mentioned and comments on it as energy source are made. 2 tables, 5 drawings.

14777 (PB—88-140769/XAB) Northeast cooperative woodstove study. Volume 1. Final report, August 1985-September 1987. Burnet, P. (OMNI Environmental Services, Inc., Beaverton, OR (USA)). Nov 1987. 319p. NTIS, PC A14/MF A01.

See also Volume 2, PB—88-140777.

This report gives results of a 2-year study in Vermont and New York, monitoring woodstove performance. The objective of the study was to determine the effectiveness of catalytic and non-catalytic low-emission woodstove technology in reducing wood use, creosote accumulation, and particulate emissions. Wood use and creosote accumulation in chimney systems were measured in 68 houses over two heating seasons (1985-86 and 1986-87). Of these houses, 42 were instrumented to measure particulate emissions and wood use. Catalytic woodstoves, catalytic add-on/retrofit devices, and non-catalytic low-emission stoves were provided by various woodstove manufacturers for use by volunteer homeowners during the study period.

14778 **(PB—88-140777/XAB) Northeast cooperative woodstove study. Volume 2. Technical appendix. Final report, August 1985-September 1987.** Burnet, P. (OMNI Environmental Services, Inc., Beaverton, OR (USA)). Nov 1987. 185p. NTIS, PC A09/MF A01.

See also Volume 1, PB—88-14069.

This report gives results of a 2-year study in Vermont and New York, monitoring woodstove performance. The objective of the study was to determine the effectiveness of catalytic and non-catalytic low-emission woodstove technology in reducing wood use, creosote accumulation, and particulate emissions. Averaged results indicate that the low-emission non-catalytic stoves and catalytic stoves had lower creosote accumulation, wood use, and particulate emissions than conventional technology stoves, although the range of values was quite large. The reductions in particulate emissions by the catalytic and low-emission stoves were not as great as could be expected based on laboratory tests.

14779 **(PNL—6422) Biomass conversion Task 4 1988 program of work: International Energy Agency Bioenergy Agreement.** Stevens, D.J. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 19p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004188/JAW.

For biomass to meet its potential as an energy resource, conversion processes must be available which are both efficient and environmentally acceptable. Conversion can include direct production of heat and electricity as well as production of intermediate gaseous, liquid, and solid fuels. While many biomass conversion processes are commercially available at present, others are still in the conceptual stage. Additional research and development activities on these advanced concepts will be necessary to fully use biomass resources. Ongoing research on biomass conversion processes is being conducted by many nations throughout the world. In an effort to coordinate this research and improve information exchange, several countries have agreed to a cooperative effort through the International Energy Agency's Bioenergy Agreement (IEA/BA). Under this Agreement, Task IV deals specifically with biomass conversion topics. The cooperative activities consists of information exchange and coordination of national research programs on specific topics. The activities address biomass conversion in a systematic manner, dealing with the pretreatment of biomass prior to conversion, the subsequent conversion of the biomass to intermediate fuels or end-product energy, and then the environmental aspects of the conversion process. This document provides an outline of cooperative work to be performed in 1988. 1 fig., 2 tabs.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

14780 **(AD-A—185605/3/XAB) Performance-limiting factors in MPD (magnetohydrodynamic) thrusters. Final report, 15 December 1984-30 April 1986.** Martinez-Sanchez, M. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Aeronautics and Astronautics). 17 Apr 1987. 57p. NTIS, PC A04/MF A01.

The following are discussed: (a) A theoretical formulation of the flow of plasma in a variable area accelerator under conditions where the voltage is dominated by the back emf, showing novel features akin to those found in ordinary gas dynamics, but with the magnetoacoustic speed playing the controlling role. (b) A numerical model of an axisymmetric MPD thruster of realistic geometry with fully coupled gas and electrodynamic effects, but limited by numerical difficulties to conditions well below onset. (c) design and construction of test channels to investigate the effects predicted by the above theories, and (d) Generation of limited computerized MPD data predicted by the above theories, and (e) Generation of a limited computerized MPD data base.

14781 **(AD-A—185674/9/XAB) Completely magnetically contained electrothermal thrusters. Technical report (Final), September 1984-August 1985.** Seikel, G.R.; Franks, C.V. (Seitec, Inc., Cleveland, OH (USA)). 5 Jul 1987. 47p. (SEITEC—8715). NTIS, PC A03/MF A01.

Conceptual designs of potentially attractive high-performance thrusters are defined. These are a kW steady-state radiation-cooled DC thruster and an MW quasi-steady DC thruster. These thrusters offer the potential for long operating life with low erosion rates and 50 to 100% improvements in performance over prior plasma thrusters. The kW thruster would be a prototype of a radiation-cooled electric thruster for future electric-propulsion missions. The MW thruster would be an inexpensive experiment to define the potential of subsequent very-high power, steady-state thrusters which would utilize superconducting magnets. The kW thruster would use xenon propellent and the MW thruster would use argon propellent. Both should operate at efficiencies of 50 to 80% in the 2500- to 3000-second specific-impulse range.

14782 **(PB—88-119631/XAB) Bulletin of the Electrotechnical Laboratory, Vol. 49, No. 6, 1985.** (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1985. 87p. (In Japanese). NTIS, PC E04/MF A01.

Table of contents include: Experimental studies on COM Burning MHD generator channels; A measuring system of stored beam current for the ETL electron storage ring and its calibration; Nonlinear calculation of resistive modes in diffuse pinches (in English); Self-stabilized pinch (SSP) concept; Extreme ultraviolet lasers - towards the x-ray laser.

14783 **Volt-ampere characteristic of an arc burning at the electrodes of a magnetohydrodynamic generator.** Berkovskii, B.M.; Brodskii, A.M.; Tikhotskii, A.S. (Institute of High Temperatures, Academy of Sciences of the USSR). *High Temperature (English Translation);* **25**: No. 3, 452-459(May 1987).

A method is outlined for calculating the parameters of an arc burning at the electrodes of an open-cycle magnetohydrodynamic (MHD) channel; the method involves the use of the channel model of the arc, complemented by the minimum principle. An analytical soluion of the energy equation is obtained, taking account of the convective and conductive mechanisms of heat transfer. Volt-ampere characteristics are calculated for arcs burning in the boundary layer of the MHD-channel electrode. The results of analytical solution lead to the conclusion of diffuse flow of the current at the MHD-channel electrode with a surface temperature of more than 2100 °K.

3003 Thermoelectric Generators

14784 **(CEA-R—5406) Contribution to the study of thermoelements in aqueous medium: theory and applications.** Blanc, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Sep 1987. 212p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88751730/JAW.

The study of thermogalvanic cells was presented in the particular case the redox couple is totally soluble and the electrodes are inerts. The bibliographical and theorical approach of the thermoelectrical phenomena was realized. The experimental study of eight redox couples allowed first the evaluation of the relative importance of the different transfer phenomena, and second their quantization on the basis of a simple electrostatic model in case of transfer on the electrodes. Redox couples studied include: Fe(CN)/sub 6//sup 3//sub //Fe(CN)/sub /6/sup 4-/, Fe/sup 3+//Fe/sup 2+/, VO/sub 2//sup +//VO/sup 2+/, Pu/sup 4+//Pu/sup 3+/, Np/sup 4+//Np/sup 3+/, PuO/sub 2//sup 2+//PuO/sub /2/sup +/ and NpO/sub 2//sup 2+//NpO/sub 2//sup +/. Finally two applications were envisaged and analysed: potentiometric titration in a gradient of temperature and direct conversion of thermic energy in electric energy.

14785 **Liquid metal thermal electric converter.** Lukens, L.L.; Andraka, C.E.; Moreno, J.B.; Abbin, J.P. pp vp of IECEC '87; Proceedings of the Twenty-second Intersociety Energy Conversion Engineering Conference, Philadelphia, PA, Aug. 10-14, 1987. Volumes 1, 2, 3, & 4. New York, NY; American Institute of Aeronautics and Astronautics (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

The design and performance of a liquid metal thermal electric converter (LMTEC) are examined. Tubular and flat plate solid configurations for a 25 kWe solar powered LMTEC were evaluated; it is determined that the tubular electrolyte configuration is the better design for the LMTEC. A computer model of a LMTEC was constructed for efficiency projections. The effects of electrode degradation, fluid flow pressure loss, and various working fluids on the performance of the converter are analyzed. A system analysis model was developed to simulate the performance of a dish electric system; it is observed that K is better than Na and that Hg is better than K as the working fluid of a dish electric system. The components of a bench test module designed for studying various concepts and configurations applicable to a solarized LMTEC are described. 5 references.

3004 Thermionic Converters

14786 **(FEI—1815) Limiting efficiency of a thermionic diode.** Kasikov, I.I.; Shcherbinin, P.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 22p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700598/JAW.

A total volt-ampere characteristics (VAC) of an ideal thermionic diode is built, its properties are studied. The expression for electron efficiency eta of the ideal diode is obtained, properties of eta=const diagram family are established. The expression for a barrier index of the envelope of the VAC family of the ideal diode is also obtained. The upper and lower limit of electron efficiency of low-voltage arc is shown. 6 refs.; 6 figs.; 1 tab.

14787 **(PB—88-131909/XAB) Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 4, 1987.** (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 94p. (In Japanese). NTIS, PC E04.

See also PB—88-131917 through PB—88-131925.

Contents include: comparison of experimental output current-voltage characteristics by a sandwich-type thermionic converter; stomach regions extraction and stomach parts recognition from barium filled x-ray images; pattern information processing and multimedia database system; performance of the solar-total-energy system experimental facility with auxiliary heater; preparation technology for thin-film solid-electrolyte fuel cells; solar thermal utilization technology in space.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 14787

14788 **(AD-A—185508/9/XAB) Hydroxide-ion conductors as possible electrolytes in intermediate-temperature fuel cells. Technical report.** Cheng, L.Y.; Crouch-Baker, S.; Huggins, R.A. (Stanford Univ., CA (USA). Dept. of Materials Science and Engineering). 30 Jul 1987. 3p. (TR—5). NTIS, PC A02/MF A01.

Prior work has shown that materials in the lithium aluminum hydroxide system can be used as hydroxide ion-conducting electrolytes at intermediate temperatures. It has been proposed that such materials may be of use as electrolytes for the electric decomposition of water. In this work, preliminary results concerning the use of materials in this system as possible fuel-cell electrolytes at intermediate temperatures will be presented. The AC ionic conductivity and thermal behavior of a material of nominal composition Li_5AlO_4 have been studied previously. A large, sudden increase in the ionic conductivity of Li_5AlO_4 in a wet environment at approximately 450 C was observed. Such behavior was not observed in a dry environment. Pure LiOH was found to exhibit similar behavior, and it was suggested that the observed conductivity increase in a wet environment is due to the formation of LiOH. In this work, preliminary results concerning the use of compositions within the Li - A1 - H system as possible fuel cell electrolytes at intermediate temperatures will be presented.

14789 **(AD-A—185541/0/XAB) Permselectivities of polyelectrolyte electrode coatings as inferred from measurements with incorporated redox probes or concentration cells.** Redepenning, J.; Anson, F.C. (California Inst. of Tech., Pasadena (USA). Arthur A. Noyes Lab. of Chemical Physics). 1987. 6p. (CONTRIB—7621). NTIS, PC A02/MF A01.

Pub. in Jnl. of Physical Chemistry, Vol. 91, No. 17, 4549-4553(1987).

Permselectivities of coatings and membranes prepared from polyanionic Nafion and from a new type of polycationic copolymer were evaluated by two methods. (i) Electroactive couples incorporated in coatings on graphite electrode surfaces served as redox probes whose apparent formal potentials changed as the concentration of supporting electrolyte was varied. The magnitude of those changes allowed the permselectivities of the coating to be surmised. (ii) Thicker layers of the polyelectrolytes were used as membranes to separate supporting electrolyte solutions of differing concentrations. The potential difference between reference electrodes placed on either side of the membrane allowed the permselectivities of the membranes to be judged. Both of the methods indicated nearly ideal permselectivity of Nafion coatings and membranes at supporting electrolyte concentrations below ca. 2 M. Ideal permselectivity continued to be registered for a Nafion membranes by the redox probe method even after the membrane had been punctured so that the bulk cation transference number was far from unity. For the polycationic copolymer, both methods indicated increasing deviations from ideal anion permselectivity as the concentration of the supporting electrolyte was increased. Interpretations and some consequences of the observations are presented.

14790 **(PB—88-131925/XAB) Preparation technology for thin-film solid-electrolyte fuel cells.** Negishi, A. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 13p. (In Japanese). NTIS, PC E04.

Included in Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 4, 59-71(1987).

In this review of thin-film technology of solid electrolyte is described together with an outline of theoretical aspect and unique advantages of solid-electrolyte fuel cells, their structure and manufacturing, and the present status of their research and development. The technology is discussed in relation to the manufacturing and the structure, which are dependent on the technology of thin-film formation.

14791 **(PNL-SA—14931) Advanced materials for solid oxide fuel cells.** Griffin, C.W.; Bates, J.L. (Pacific Northwest Lab., Richland, WA (USA)). 1987. Contract AC06-76RL01830. 21p. (CONF-8705103—13). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002338/JAW.

From Fossil energy materials program conference; Oak Ridge, TN, USA (19 May 1987).

Materials based on the In_2O_3-PrO/sub 1.83/-ZrO_2 system were examined as potential electrodes and current interconnects for solid oxide fuel cells (SOFC). The electrical transport, thermal, and electrochemical properties are described in relationship to structure, phase equilibria, and composition. The electrical conductivity was dependent on structure and composition, and can exceed the conductivity of the state-of-the-art electrode/interconnect materials. The instability of the In_2O_3 in reducing environments may eliminate this system as SOFC anodes or interconnects. This system may be used as cathodes if indium does not diffuse into the electrolyte and degrade fuel cell performance. 4 refs., 8 figs., 4 tabs.

14792 **Fuel cell + concentrator.** Taylor, E.J.; Waterhouse, R.; Gelb, A. (Physical Sciences, Inc. (Research Park, P.O. Box 3100, Andover, MA 01810). *CHEMTECH;* 17: No. 5, 316(May 1987).

Electrochemical industries consume about 7% of all the electric power produced in the United States, and the production of chlorine and caustic soda by the chlor-alkali industry accounts for the equivalent energy consumption of 287,000 barrels of oil daily. Clearly, any improvement in chlor-alkali process efficiency would have a significant impact on U.S energy consumption. Mercury, diaphragm, and membrane electrolysis cells currently dominate the

electrolytic chlorine-caustic industry. The authors discuss membrane cells because they represent the emerging technology.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 14773

14793 (SERI/SP—254-2916) Tips for saving energy in small businesses. (Solar Energy Research Inst., Golden, CO (USA)). 1988. Contract AC02-83CH10093. 28p. OSTI, PO Bx 62, Oak Ridge, TN 37831. Order Number DE88005096/JAW.

This booklet is divided into the following sections: introduction, utility rates, buildings, lighting, systems, hot water, resources, and glossary.

3201 Buildings

REFER ALSO TO CITATION(S) 14396, 14457, 14460, 14464, 14465, 14837, 15291, 15989, 16006, 16093

14794 (A/RB—1814E) Energy-conserving urban greenhouses for Canada: construction and management. (Department of Agriculture, Ottawa, Ontario (Canada). Research Branch). 1987. 155p. (In English and French). (MICROLOG—87-05742). Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, Ont., Canada K1A 0S9; $6.75 CANADA, OTHER COUNTRIES $8.10 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

There is a great deal of public interest in both energy-conserving and solar greenhouses. This book provides basic information on the usefulness of these greenhouses and explains the theory behind their constuction and management, and estimates cost. Several important references are listed in a resource bibliography.

14795 (BMFT-FB-T—86-227) Systems for exploitation of solar, wind and biogas energy in the People's Republic of China. Phase II. Partial project planning of settlement and buildings. Final report. Schreck, H.; Hillmann, G.; Nagel, J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Institut fuer Bau-, Umwelt- und Solarforschung G.m.b.H., Berlin (Germany, F.R.)). Dec 1986. 71p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751659/JAW.

For the purposes of the entire project several passive solar buildings had been planned and constructed as residential and office buildings for the village of Yihezuang: one- and two-storey farmhouses, school with kindergarden, brigade building, guest house, stables. The energy supply of all buildings should be reduced by applying planning and construction methods under consideration of traditional building forms. The required heat energy demand should be covered by employing simple passive methods of solar energy use. The reduction of the energy supply had been achieved by insulating the outer walls and by installing temporary insulation devices for windows and doors. The ground floor is designed in zones. The passive energy gain is as well direct and indirect (trombe walls, wintergarden effect). The testing and measuring phase lasted 2 years and confirmed the calculated solar demand of the total heating supply. The buildings serve as a prototype for further construction activities in the rural areas of Northern China. With 7 tabs., 104 figs..

14796 (BMFT-FB-T—86-233) Development of a standard test procedure for heat recovery units in air conditioning plants for residential buildings. Final report. Esdorn, H.; Kuelpmann, R.; Rueden, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Technische Univ. Berlin (Germany, F.R.). Hermann-Rietschel-Institut fuer Heizungs- und Klimatechnik). Dec 1986. 133p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751658/JAW.

The increasing number of heat recovery units in air conditioning plants of residential buildings gives the necessity for a standard test procedure. A test facility has been built at the Hermann-Rietschel-Institut which enables one to investigate heat recovery units of the category I, II and III according to VDI Guideline 2071/1 for all usual installations and meteorological conditions. Based on the test results and the information found in the literature the test methods and test conditions are specified to determinate efficiencies for temperature and for humidity as well as the rate of air leakage and the performance for condensing and freezing. Also named are criterians for the technical conditions and regulation equipments. An example for a test report is presented. With 21 refs., 13 tabs., 44 figs..

14797 (BMFT-FB-T—86-234) Demonstration project Worms. Comparative investigation of various air conditioning systems in buildings. Vol. 1. Final report. Bley, H.; Dittert, B.; Damberg, W.; Jenisch, H.; Seifert, B.; Drews, M.; Nagel, R.; Schoendube, M.; Ulrich, D.; Prescher, K.E. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.); Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene). Dec 1986. 126p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751655/JAW.

Contents of Volume 1: 1) Building description: Structural parameters were determined and heat consumption measured; large safety margins have resulted in considerable over-dimensioning. 2) Hygiene: 2.1) Air quality: Measurements of nitric oxide, formaldehyde and a variety of organic compounds showed no differences. 2.2) Air changes: Natural ventilation through window gaps results in 0.1-0.2 changes per hour, mechanical ventilation in 0.5-0.8/h. 2.3) Freedom from draught: Because of the design of the air outlets draught must be expected in the rooms. 2.4) Noise level: More care is necessary here because measured values exceed permissible levels. With 52 tabs., 48 figs.

14798 (BMFT-FB-T—86-235) Demonstration project Worms. Comparative investigation of various air conditioning systems in buildings. Vol. 2. Final report. Bley, H.; Dittert, B.; Hofmann, W.; Neeb, B. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). Dec 1986. 133p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751654/JAW.

Contents of Volume 2: 3) Energy balance: The measurements and associated calculations proved that heat consumption can be reduced by about 15 to 20% as a result of mechanical ventilation and heat recovery systems. 4) Heat cost distribution: The minimum requirement for this is the separate measurement of energy consumption for room-heating, hot water supply and air heater in the building. 5) Planning and implementation: When planning and realizing these systems care should be taken that overdimensioning is avoided, approval according to VDI 2079 is obtained, and fire-protection requirements are fulfilled. 6) Economy: Systems of this kind pay back after 12 to 16 years. When the dissipated heat is utilized by a heat pump for warm water heating, however, the payback period is only 5 to 8 years. With 24 tabs., 32 figs.

14799 (BMFT-FB-T—86-236) Demonstration project Worms. Comparative investigation of various air conditioning systems in buildings. Vol. 3. Final report. Gizycki, R. von; Herwig, E.; Held, M.; Neumann, G.; Thorpe, W.; Seibel, K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). Dec 1986. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751653/JAW.

The objective of this work package was to determine whether and to what extent different air conditioning systems have an impact on the opening of windows to let in fresh air. The relevant observations included 230 residential units (flats). Results: (1) Mechanical air conditioning in private houses is not necessarily accompanied by a reduction of window aeration. In fact, window aeration seems to be done largely out of habit. (2) A significant influence of

objective societal data on window aeration was not identified. (3) By contrast, the condition of the buildings and the heating costs appear to influence the user behaviour. With 20 tabs., 2 figs.

14800 **(BMFT-FB-T—86-237) Demonstration project Worms. Comparative investigation of various air conditioning systems in buildings. Vol. 4. Final report.** Bley, H.; Dittert, B.; Damberg, W.; Gizycki, R. von; Herwig, E.; Hofmann, W.; Jenisch, H.; Neeb, B.; Neumann, G.; Thrope, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.); Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene). Dec 1986. 41p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751705/JAW.

The R and D program 'Air Infiltration and Ventilation in Buildings' included a demonstration phase in which three blocks of flats (40-50 units each) at the outskirts of Worms were equipped with a mechanical air infiltration and ventilation system with heat recovery, a mechanical ventilation system (DIN 18017, Bl. 3+4), and a thermal current system (DIN 18017, Bl. 2, 1961), respectively. The investigations included: Volume 1 - building description, hygiene, air quality, air changes, protection from draft, noise level; Volume 2 - energy balance, individual heating costs, efficiency calculations, planning and installation experience; Volume 3 - user behaviour. According to comparative measurement systems with heat recovery permit a ca. 15-20% reduction of heat consumption. User behaviour (window ventilation) is dependent on habit. With 11 tabs., 6 figs..

14801 **(BMFT-FB-T—86-240) Requirements for an energy-economical use of ventilation systems in residential buildings. Final report.** Meyringer, V. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.). Abt. Neue Technologien - Energie). Dec 1986. 90p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751652/JAW.

The report summarizes results of phase I 'Investigations' and phase II 'Demonstration projects' of the programme 'Ventilation in buildings'. It appeared that ventilation has to be connected with measures ensuring sufficient indoor air quality, i.e. removal of moisture, other pollutants and odours. The air change rates should not be less than 0.5 p.h. Today demand-controlled and economic air exchange only with ventilating systems is possible. Systems for natural ventilation require further developments, but also mechanical systems did show some imperfections. The inhabitants behaviour is dominated by subjective impressions and traditional behaviour patterns. New ways of information and motivation are needed. With 43 refs., 8 tabs., 15 figs.

14802 **(BNL—52102) Impact of burner design features on sooting in residential oil fired systems.** Butcher, T.; McNeill, F.; Celebi, Y.; Wegrzyn, J. (Brookhaven National Lab., Upton, NY (USA)). Nov 1986. Contract AC02-76CH00016. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005322/JAW.

This report describes the results of a study on soot production by residential oil burners with an emphasis on condensing system applications. The work has followed a related study at Brookhaven National Laboratory completed in June 1984. Work in the current project has been aimed at the effects of specific burner design features on soot. Soot production during burner startup and shutdown has been shown to be significant for heat exchanger fouling in some systems. A new method has been developed for measuring transient smoke involving a multipass light extinction technique. A general review of soot measurement techniques and the details of the system used in the experimental work are included. Specific burner design features evaluated include high static discharge pressure fans, high startup excess air, nozzle and fuel line heating, burner heat pressure drop, and fuel flow control. Both high pressure fans and high startup excess air were found to significantly improve startup behavior. This result is consistent with simple flow models in which a furnace or boiler system is related to a cavity resonator. Measurements showed that nozzle heating can significantly improve spray droplet size distribution. Tests in both condensing and non-condensing systems indicated that a commercial nozzle heater reduces smoke over the first two minutes of operation. The effect was most significant at low excess air.

14803 **(DOE/CE/63486—T1) Energy-related business development grant project: Final report, January 1, 1986-June 30, 1987.** (Ramsey Action Programs, Inc., St. Paul, MN (USA)). 1987. Contract FG01-86CE63486. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004078/JAW.

This document is a final report on the activities and results of the DOE Business Initiative Grant. The report is written to give a full accounting of our activities and will hopefully serve as a useful "guide" to other Weatherization Assistance Program deliverers about how they may examine and establish fee-for-service operations in a manner that is fiscal and operationally consistent with the operation of the Weatherization Assistance Program. We should hasten to say that our report is not a generic "how-to" guide for other agencies; nor is our report an exhaustive reflection of all the information we considered or collected. Also, our report clearly reflects only what we did and is in the context of our needs and circumstances. Our actions were done in response to the specific actors involved in our agency.

14804 **(ECRC/M—2193) Infiltration rates in a tight house with a fireplace.** Dickson, D.J. (Electricity Council Research Centre, Capenhurst (UK)). Sep 1987. 24p. Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.

Research memorandum concerning the measurement of infiltration increase due to the provision of an open fireplace in an otherwise tight house. Measurements were made by tracer decay methods. They showed that if the fireplace closure plate was used and the air vent left open an increase in whole house infiltration rate of 0.2 air changes/hour could be expected. Closing the air vent reduced this increase to 0.1 air changes/hour.

14805 **(EFI-TR—3411) Main findings of load research in Norway between 1980-1985.** Livik, K. (Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)). Mar 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751198/JAW.

Load measurements for various types of buildings were collected and analyzed. This enabled the annual curves, the load duraton curves and the daily curves to be determined. In addition, specific values for energy consumption and peak demand have also been calculated, and the dependence of energy consumption upon temperature determined. All results are presented as typical values for the different types of buildings. 25 figs., 21 tabs.

14806 **(EMR—87/1E) Fans and pumps.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1987. vp. (MICROLOG—87-05753). Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, Ont., Canada K1A 0S9; $9.50 CANADA, OTHER COUNTRIES $11.40 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report introduces the functions of fans and pumps as used in the industrial, commercial and institutional sectors, define methods of determining approximate energy consumption, provide an awareness of potential energy and cost savings available through the implementation of energy management opportunities, and a standard method of calculating energy and cost savings. This is a presentation of information and calculation tools which can be used to identify energy management opportunities and to estimate potential energy and cost savings.

14807 **(EMR—87/2F) Fans and pumps.** (Ministere de l'Energie, des Mines et des Resources, Ottawa, Ontario (Canada)). 1987. vp. (In French). (MICROLOG—87-05752). Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, Ont., Canada K1A 0S9; $9.50 CANADA, OTHER COUNTRIES $11.40 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report introduces the purposes and functions of fans and pumps as used in the industrial, commercial and institutional sectors, define methods of determining approximate energy consumption, provide an awareness of potential energy and cost savings available through the implementation of energy management opportunities, and provide a standard method of calculating energy and cost savings for the noted energy management opportunities. This is a presentation of information and calculation tools which can be used to identify energy management opportunities and to estimate potential energy and cost savings.

14808 **(KTM/E-B—65) Comparison of electricity and heating costs of small houses.** Kaerkkaeinen, S.; Rouvali, J.; Sipilae, K.; Haakana, M.; Haalahti, P.; Oravainen, H. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Jun 1987. 74p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751180/JAW.

The comparisons have been made for three different types of houses. In a new 120 m"2 and 420 m"3 small house several kinds of heating alternatives based on electricity, oil, district heat, natural gas and domestic solid fuels are compared at three different types of municiplities. The comparisons are based on the annual costs when the real rate of interest is 5% and the period of amortization corresponds to the life times of appliances and structures. The most economic alternatives in the calculations were oil heating, direct electric heating, and gas heating. The results depend on the heat consumption of the house, local tariffs, the price level of the domestic fuel etc., and they cannot be applicable for all individual cases. According to the study, the total electricity and heating cost of most heatingalternatives doesn't vary much. Thus other grounds may lead to the choice of heating system. Among them e.g. the proportion of investments and service costs, expectations of future costs, ease-of-use, and dependability, replaceability and environmental factors of the energy resource. In the renovation of the heating system of an old 125 m"2 and 440 m"3 oil heated house, it is usually economic to stay in oil heating at the present price level of oil, and make improvements in the existing oil heating. In an old firewood stove heated house (80 m"2, 270 m"3) the direct electric heating is usually the most simple way in the renovation, and usually it is worthwhile to maintain the old stoves.

14809 **(LBL—22156) Windows and lighting program: Applied Science Division: Annual report, Fy 1986.** (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000683/JAW.

Despite the important achievements in reducing building energy consumption over the last decade, significant additional savings are still possible. These will come from two complementary strategies: (1) better building designs that effectively apply existing technology and extend market penetration, and (2) new advanced technologies to increase the savings potentials with each application. Both the Windows and Daylighting and Lighting Systems Research groups have made substantial contributions in each of these areas. The ongoing research described in the annual summary aims to further advance achievement of these goals.

14810 **(NEDO-P—8624) Enquete and hearing survey on energy consumption in commercial sector.** (New Energy Development Organization, Tokyo (Japan)). Mar 1987. 247p. (In Japanese). NTIS (US Sales Only), PC A11. Order Number DE88770048/JAW.

This report contains the results of a literature survey and a questionnaire survey which have been conducted for the past two years concerning the energy consumption in the commercial sector, for which only poor statistical data and survey systems have been available. The floor space in buildings for business use, which is considered to be the most important parameter among the various activity indicators reflecting the energy consumption in the commercial sector, is calculated at a total of 1,102,930,000 m^2 in 1985 in Japan. The annual specific energy consumption is calculated for various business areas. Results show that it is 103.0 Mcal/m^2 in hotels and inns, and 426.4 Mcal in hospitals and medicals in schools and research organizations, 497.2 Mcal/m^2 facilities. This report also contains data on specific energy consumption in the service business areas that have previously been published elsewhere. The total demand in 1985 is estimated at 173,142 billion kcal, multiplying the total floor space by the specific energy consumption in each business area. (107 figs, 134 tabs)

14811 **(NEI-DK—53) Investigation of the durability of 3-layer glazing units.** Brandt, A. (Jysk Teknologisk, Aarhus (Denmark). Byggeteknik). Dec 1984. 36p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751084/JAW.

An investigation of the durability of 3-layer double glazing units has been performed within the framework of the Danish Energy Research Programme EFP 82. It is a well-known fact that in the case of 3-layer glazing units the sealant is exposed to greater stress than is the case for double glazing units by changes in temperature and pressure. The purpose of the investigation was to establish how small a size of 3-layer glazing units was permissible. A number of calculations have been made of glass stresses and deflections for various sizes of glazing units by changes in temperature and pressure. Moreover, a number of units have been exposed to accelerated aging experiments in accordance with DS 1094.4. The conclusion of the investigation is that for 3-layer glazing units it must be recommended to observe the minimum edge lengths recommended by the Norwegian Building Research Institue. Air space 12 + 12 mm, min. 0.8 m. Air space 9 + 9 mm, min. 0.6 m. Air space 6 + 6 mm, min. 0.4 m.

14812 **(ORNL/Sub—83-47985/1) Free-piston Stirling engine diaphragm-coupled heat-actuated heat pump component technology program: Phase 1B, Final report.** Ackermann, R.A. (Mechanical Technology, Inc., Latham, NY (USA)). Sep 1987. Contract AC05-84OR21400. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88003653/JAW.

In Phase 1 of the Diaphragm-Coupled Heat Pump Compressor Development Program, a free piston Stirling engine (FPSE) driven heat pump power module was designed, fabricated, and tested. The power module consisted of a natural gas combustor, FPSE, hydraulic transmission, and refrigerant compressor. A major problem encountered with this hardware was the shortfall in rated heating and cooling capacity. To determine the causes of the shortfall, an analytical investigation was conducted during Phase 1A. During Phase 1B of the program, described herein, several of the more important losses identified in Phase 1A were investigated experimentally. In particular, hardware associated with the critical clearance seals in the hydraulic transmission was modified, and several different hydraulic transmission fluids were tried. The results were encouraging in that improvements made to the hydraulic transmission produced a capacity increase from 1.0 to over 2.0 tons of cooling. However, the increase to 3.0 tons was not achieved. The testing did show conclusively, though, that the internal counterweight was responsible for the largest loss in the hydraulic transmission and, in order to achieve a significant increase in capacity, the internal counterweight would have to be removed.

14813 **(ORNL/Sub—86-47985/1) Free-piston Stirling engine diaphragm-coupled heat-actuated heat pump component technology program: Phase 1C, Final report.** Ackermann, R.A. (Mechanical Technology, Inc., Latham, NY (USA)). Jul 1987. Contract AC05-84OR21400. 151p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88003654/JAW.

During Phase I of the Heat-Actuated Heat Pump Development Program, a Breadboard Heat Pump power module consisting of a free-piston Stirling engine (FPSE), a hydraulic transmission, and a linear-resonant refrigerant compressor was designed and fabricated. The essential ground rule of this development was the use

of an existing Mechanical Technology Incorporated FPSE. During testing, this breadboard heat pump fell far short of its design capacity of 3.0 tons of cooling at 95°F ambient conditions. In Phases IA and IB, excessive losses in the hydraulic transmission were identified as the cause of the shortfall in capacity and the hydraulically driven counterweight inside the transmission as the major cause of the high loss. The object of Phase IC of the program was to replace the internal counterweight with an external vibration absorber and to test the breadboard heat pump, shown over a broad range of ambient conditions from 0 to 95°F. The work elements of the Phase IC program addressed the design, fabrication, and test of the external absorber, the development of a comprehensive test plan for the breadboard heat pump, and the steady-state testing of the heat pump to determine its performance in both the heating and cooling modes. The specific objectives of the testing were, first, to operate the heat pump over a range of ambient conditions from 0 to 95°F; second, to establish the steady-state performance of the unit at each of these points; and third, to achieve a minimum cooling capacity of 2.5 tons at the 95°F ambient conditions. The results are discussed in this report.

14814 **(ORNL/TM—10414) Thickness and density measurements for attic loose-fill thermal insulations in eight cities.** Yarbrough, D.W.; Graves, R.S.; McElroy, D.L. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 154p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88001488/JAW.

Thickness and density data for loose-fill thermal insulation installed in residential attics have been obtained in eight cities during the period 1979 through 1986. The field data provide a basis for estimating the amount of insulation settling that occurs after installation. The field study has progressed through stages of increasing complexity to include: (1) density measurements 1 to 10 years after installation; (2) monitoring of insulation density and thickness with time, starting with installation; and (3) monitoring of insulation density and thickness with time, starting with installation at densities near the manufacturer's recommended value. The first part of the study revealed unexpectedly high insulation densities. The latter parts of the study have shown that settling continues for about 2 years after installation. Sufficient data were collected to construct correlations that can be used to predict final thickness or density values for the products that were tested. The mineral fiber insulations installed near label density showed thickness loss in the range of 6 to 7% while products installed at densities 20% or more above the manufacturer's recommended value did not settle. Data obtained for loose-fill cellulosic insulation shows settling for at least 2 years that can be correlated with results from the blower-cyclone-shaker test for settled density. This report includes an analysis of the effect of settling on R-value and correlations that are useful for calculating R-values from thickness and density measurements.

14815 **(PB—88-124789/XAB) Annual housing survey: 1983. United States and regions, Part F: energy-related housing characteristics.** (Bureau of the Census, Washington, DC (USA)). Sep 1985. 208p. NTIS, PC A10/MF A01.

See also PB—84-208313.

This report presents statistics on energy-related housing characteristics from the 1983 Annual Housing Survey for the United States, by inside and outside standard metropolitan statistical areas (SMSA's) and each of the four geographic regions. The Annual Housing Survey (AHS) was designed to provide a current series of information on the size and composition of the housing inventory, the characteristics of its occupants, the changes in the inventory resulting from new construction and from losses, the indicators of housing and neighborhood quality, the characteristics of recent movers, and the characteristics of urban and rural housing units.

14816 **(PB—88-142187/XAB) Residential gas heat pumps: a developing technology.** (Gas Research Inst., Chicago, IL (USA)). 1987. 12p. (GRI—87/0331). NTIS, PC A03/MF A01.

GRI has selected three gas heat pump (GHP) concepts as the most promising for early commercialization and growth potential: dual-cycle absorption, reciprocating engine-driven, and rotary engine-driven. The near-term objective is to achieve market entry of an absorption GHP, an adsorption GHP, or an internal combustion (IC) engine-driven GHP in the early 1990s. If on-going R&D on free-piston Stirling engine technology is successful, a GHP based on the technology could also be available by 1995. Analysis of the residential market shows that the GHP can best compete in residences having a high heating load or in warm regions where the electric-to-gas price differential is especially high. The absorption type is best suited for high-heating-load regions while the IC engine-driven GHP is best suited for cooling-dominated regions. Major research issues for all GHP types continue to be initial-cost, high-performance, reliability, and long life.

14817 **(PU/CEES—219) Energy conservation in buildings: 1986-1987.** Harrje, D.T. (Princeton Univ., NJ (USA). Center for Energy and Environmental Studies). Nov 1987. Contract FG01-86CE23838. 30p. NTIS, PC A03. Order Number DE88005018/JAW.

From its inception, the Center for Energy and Environmental Studies has been conducting vigorous research into energy efficiency improvements in US housing, focusing initially on existing single-family houses and then moving to more complex multifamily buildings. The highlights of this activity characterized by the most notable results each year are shown. Our research has evolved on the demonstrable premises (1) that existing housing may be "retrofitted" to consume far less energy, while protecting the structure with no loss of amenity to the occupants, (2) that the proper evaluation of buildings necessary to achieve large energy savings leads to many results contrary to conventional wisdom, and (3) that professional time in a building is a valuable resource so that our research efforts must lead towards the strategy for optimum utilization of this resource. The research generally falls into two categories: Building Science and Retrofit Field Studies.

14818 **(STF—11A86037) Evaluation of hot-water heating in connection with water/water source heat pumps.** Eggen, G. (SINTEF, Trondheim (Norway)). Sep 1986. 14p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751224/JAW.

The report gives an evaluation of combined under-floor and hot-water heating systems, and with water source heat pumps connected. The annual operating costs and energy saving potential for the various systems are presented. 6 drawings.

14819 **(STF—15A85041) Sun - Small scale modelling of houses under the influence of solar heating. Subreport 1. Modelling criteria.** Jacobsen, T. (SINTEF, Trondheim (Norway)). Jul 1985. 44p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751119/JAW.

The report deals with model laws and methodology for small scale modelling of houses under the influence of significant heat sources such as solar radiation. The main concerns for the modelling are interactions between the solar heated areas, heat transfer, air temperatures and air circulation. In addition to natural air circulation, forced air movement/circulation is of interest. The following factors for scaling are considered: 1. Geometric dimensions. 2. Heat transfer - convective, conductive, radiative 3. Thermal capacities 4. Time scale 5. Short wave radiation 6. Fluid velocities (air) 7. Viscosity 8. Practical limitations. 13 drawings.

14820 **(STF—15A86024) Solar heating plant at the Stavanger squash center. Test results 1985.** Drangsholt, F. (SINTEF, Trondheim (Norway)). Apr 1986. 31p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751124/JAW.

The report deals with the solar heating plant at the Stavanger squash center (Norway). The behaviour and efficiency of the plant are presented and discussed. Test results are given. 7 drawings, 3 tables.

14821 **(STF—15A86052) Glazed yard climate in the Kredittkassen office block in Middelthunsgt. 17.** Novakovic, V.; Harsem, T.T. (SINTEF, Trondheim (Norway)). Sep 1986. 20p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751121/JAW.

The report deals with the glazed yard climate in the Kredittkassen head office block in Oslo (Norway). The climate has been simulated by means of the computer program Royal-DEBAK. Considered in particular are the summery and bright sunny day conditions together with the annual power required and energy consumption. The use of insulating glasses, indoor curtains, ventilation systems in the narrow zone of the glass roof, and cooling systems in the floor are important parts of the concept. 9 drawings.

14822 **(STF—15A86053) Solar heating plant at the Stavanger squash center. Test results 1986.** Drangsholt, F. (SINTEF, Trondheim (Norway)). Oct 1986. 35p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751125/JAW.

The report deals with the solar heating plant at the Stavanger squash center (Norway). The behaviour and efficiency of the plant are presented and discussed. Test results are given. 7 drawings, 3 tables.

14823 **(STF—15A87012) Controlled ventilation demand.** Drangsholt, F. (SINTEF, Trondheim (Norway)). Mar 1987. 41p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751215/JAW.

The report deals with the energy saving potential of controlled ventilation systems when human body odour is the main source. The system is equipped with a CO-2 indicator to control the ventilation capacity for the various load conditions. The airflow pattern according to different operation conditions, is an important value for the evaluation of such types of ventilation systems in order to obtain increased efficiency. Practical experiences and test results are presented. 28 drawings, 3 tables.

14824 **(STF—45A85001) Results from controlled energy consumption in practice.** Kjaer, M.; Naavik, G.; Lillevik, O.; Oland, G. (SINTEF, Trondheim (Norway)). Mar 1985. 163p. (In Norwegian). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751216/JAW.

The report discusses the energy saving potential, various conservation measures and control systems and electric demand profiles for a number of 26 electric heated row-house residences at Heimdal in Trondheim (Norway). The saving potential of wood-fuelled stoves is also considered. 90 drawings, 9 tables.

14825 **(STF—62A86004) 14 low-energy houses at Heimdal. Pt. 11. Energy saving in detached houses - Experiences, recommendations, final report.** Granum, H.; Raaen, H. (SINTEF, Trondheim (Norway)). Apr 1986. 70p. (In Norwegian). NTIS (US Sales Only), PC A04. Order Number DE88751133/JAW.

The report summarizes results and experiences from 14 low-energy houses at Heimdal in Trondheim (Norway), and is partly supplied by results from other types of research projects. Consequences for the energy consumption in detached houses are discussed. Following aspects are compared, such as location, design, thermal insulation, airtightness, ventilation and heat recovery, control of indoor temperature, heat pump systems, solar heating systems, and utility habits. The emphasis of the report is on the economic evaluation of different saving measures. 18 drawings, 2 tables.

14826 **(STF—62A86006) Energy- and temperature analysis for the nursery school Romemyra.** Bryn, I. (SINTEF, Trondheim (Norway)). Jun 1986. 20p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751128/JAW.

The report deals with an analysis on the energy- and temperature conditions for a nursery school in Trondheim (Norway). The total floor area is 490 m/sup 2/ which consists of a semiclimatized glazed yard of about 80 m/sup 2/. The analysis is done by means of the computer program Royal Debac. The ventilating air is preheated in a heat exchanger and then postheated in the yard by the solar flux before entering the air conditioning system. A comparative evaluation of the energy consumption is done in relation to a conventionally built nursery school. The saving potential is found to be 55 %. 5 drawings, 1 table.

14827 **(STF—62A86009) 14 low-energy houses at Heimdal. Pt. 9. Energy consumption - Test results.** Haugen, T.; Fredriksen, A. (SINTEF, Trondheim (Norway)). Aug 1986. 354p. (In Norwegian). NTIS (US Sales Only), PC A16. Order Number DE88751187/JAW.

The report deals with the test results and analyses for a number of 14 low-energy houses at Heimdal in Trondheim (Norway). On the basis of recorded and processed periodical test results, the energy consumption is compared and analysed. In the appendix the hourly energy consumption is presented in both tabular and graphic forms. 16 drawings, 7 tables.

14828 **(STF—62A86017) 14 low-energy houses at Heimdal. Pt. 10. 3 solar heated houses.** Gunnarshaug, J. (SINTEF, Trondheim (Norway)). Dec 1986. 68p. (In Norwegian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751186/JAW.

The present report sums up the background, aims, plans, design, systems, test results and practical experiences from 3 solar heated houses at Heimdal in Trondheim (Norway). The houses have the same size, design and insulating layers, but different solar heating systems. Great differences regarding the energy demand for the houses are recorded. The double-shell houses were the most energy efficient buildings, but the difference for the annual heating demand was about 10000 kwh. 29 drawings, 4 tables.

14829 **(VTT-TIED—687) Optimization of domestic hot water production and energy economy.** Tormonen, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Mar 1987. 39p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751096/JAW.

Factors that effect on domestic hot water production were studied in laboratory conditions in various heating systems. Whether over dimensioning or ready-to-operate loss have influence on the energy economy in these systems was also researched. The effects of the chosen boilers were from 200 kW to 300 kW. The temperatures of domestic hot water were measured in variable using conditions. As variables were: the flow rate of domestic water, the starting temperature and circulation speed of boiler water as well as the burner and the heating effects. It was found out that these variables had the greatest influence on domestic hot water temperature in such arrangements where the heat exchanger of the hot water in the outlet. When the circulation speed of boiler water was changed from 3.5 m"3/h to 8.4 m"3/h the hot water effect increased about 40% in these solutions. The corresponding change was remarkably smaller in the reservoir type of arrangement in similar conditions. Using a reservoir with a water flow rate 1.2 l/s and running time of 7 minutes the hot water effect was 1.5 times the burner effect. What the influence of over dimensioning on energy economy becomes depends on its effect on the ready-to-operate loss and the burning efficiency. Domestic hot water is often possible to be produced in a smaller water volume. The effect on energy economy is positive because of a smaller ready-to-operate loss and further more the system needs less space.

14830 **(VTT-TIED—700) Influence of wind on the mechanical ventilation of a detached house.** Luoma, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Apr 1987. 44p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751095/JAW.

The purpose of this study was to investigate the influence of wind on the mechanical ventilation of a detached house. Calculations were made by using a network model. The leakage air rates through the outside walls were calculated on different wind directions and speeds. The stability of the leakage air to different rooms was studied by using long-term wind statistics. Calculations were also made with reduced capacity of mechanical exhaust fan and with different air relations between mechanical inlet and exhaust air.

14831 **(VTT-TIED—721) Direct digital control (DDC) in the control of heating and air-conditioning systems.** Katajisto, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). May 1987. 67p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751087/JAW.

Direct digital control can be defined as control in which the functions of a controller are performed by a digital device. Digital controllers are programmable, which is the main difference between them and analog controllers. The use of DDC in the control of heating and air-conditioning systems will become more and more common. Reasons for that are the rapid development of microprosessor technology, the relative reduction in the prices of computers as well as the requirements for better thermal comfort conditions in room spaces and for more accurate performance of control systems. In the last few years more and more articles and conference papers have been published on direct digital control of HVAC-systems. The objective of this literature review is to produce a summary of those papers and articles, to get a vision of the future trends and to introduce research and development needs. The report deals with the functions of digital control systems in general, the differences between digital and analog control; and the design of direct digital control of HVAC-systems. Some illustrative examples of the use of DDC in the control of HVAC-systems are presented. Some important digital control terms are explained, as well. As a summary, the R and D needs for the next few years are discussed. Those needs contain the R and D work that is most important for the Finnish control industry. A fact and perhaps the biggest problem in this field in Finland is that international control companies dominate also the Finnish market, which is only a minor part of the world market. So, it is not realistic to think that they would take into account the R and D needs of Finland.

14832 (VTT-TIED—727) Electrochromic thin films. Nyman, C.; Gullenberg, U.; Leppihalme, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1987. 45p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751099/JAW.

An electrochromic material has the property of changing color when voltage is applied across the material. It is possible electronically to alter a window's transmission and reflection properties by use of electrochromic thin films. This allows regulation of conductive and radiative heat transfer rates, with variable optical attenuation in the visible and infrared part of the solar radiation. Suitable materials for electrochromic films are transition metal oxides, such as tungsten and molybdenum. In the study we consider the theory of electrochromism, device technology and different materials and their applications. Electrochromic thin films have been made on glass substrates to show the fabrication method. The films have been produced by DC-sputtering in different atmospheres. For energy efficient window shutters the important characteristics are solar-matched spectral response, low power, wide operating temperature and wide range of intensity response. Shutters should also be programmable and manually controlled according to heating and cooling needs and should withstand solar radiation, weather and cleaning. Last of all, the fabrication of material needs to be cost effective.

14833 (VTT-TIED—742) Adjusting of temperature in microscale airconditioned cover. Esala, V.-P. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1987. 27p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751173/JAW.

Calibration of the measuring gauges requires very good conditions. A normal room is not good enough. However, an air-conditioned room is often a too expensive solution. One possibility is small air-conditioned space in the measuring room. During the research an micro scale (1.5 m"3) air-conditioned cover was built over a big measuring flat stone. The temperature of the cover can be adjusted by adjusting the temperature of the water running inside the stone. The temperature of the water is adjusted with a combination of a thermostat and bath. An external pump leads the water to the stone through 9 meters tubes. In addition to the stability and accuracy, the temperature of the micro scale air-conditioned cover can easily be adjusted to about 5-8 deg C around the temperature of 20 deg C. Even a larger adjusting area is possible, but the flatness of the stone depends to a great extent on the temperature. Although it can be adjusted, the temperature of the micro scale air-conditioned cover depends on the variation of the outdoor temperature. However, the temperature stability of the micro scale air-conditioned cover at 20 deg C is about +-0.1 deg C/7 h and it is adjustable to an accuracy within +-0.2 deg C. By circulating the air with a fan the temperature stability is about +-0.05 deg C/7 h and accurate to within +-0.10 deg C.

14834 (VTT-TUTK—422) Constancy of air tightness in buildings. Metiaeinen, P.; Saarimaa, J.; Saarnio, P.; Salomaa, H.; Tulla, K.; Viitanen, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Sep 1986. 170p. (In Finnish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751107/JAW.

In order to reduce consumption of energy more air tight buildings have been built. There were many doubts, that too air tight construction can cause some harm to indoor climate and structures. It was also unclear whether the building would remain air tight with time. In the study, pressure measurements have been carried out to discover whether the air tightness of mainly detached houses changes with time. The study consists of 34 new buildings and 9 old improved buildings. The air tightness of the building envelope decreased significantly in energy two buildings during the two first years. The change occurred mainly in timber framed buildings In many cases it was very difficult to detect any specified causes to reduced air tightness. In timber framed buildings drying of wood is one notable reason. It causes small cracks all over the building envelope and reduces thus the air tightness evenly. The study of the inconveniences caused by too air tight constructions was carried out by sending inquiries to the holders of real estate. Some buildings were then thoroughly inspected and measured. The study showed that too air tight as well as too leaky constructions cause much harm. Draught and bad smell of indoor air seemed to be quite common in flats. The window pane became misty in several buildings, whereas moisture defects inside the constructions were rare. The radon content was measured in several buildings, and very low concentrations were found. The problems of indoor climate were significantly connected with poor ventilation. The main problem was the insufficient use of mechanical ventilation devices and the incompatibility between the ventilation system and air tightness, in other words, the air change rate was out of control.

14835 (VTT-TUTK—471) Influence of moisture on heat transfer in structures. Kohonen, R. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Mar 1987. 61p. (In Finnish). NTIS (US Sales Only), PC A04. Order Number DE88751097/JAW.

Influences of moisture and moisture transfer on heat transfer in fibrous insulant was studied theoretically, with calculations and experiments. When evaluating the effect of moisture on the thermal performance of a wall structure, we must know the moisture content, hygrothermal transport properties and boundary conditions of the structure. Thus it is possible to determine the phases, distribution and flow rate of moisture, from which the heat flow rate in the structure can be calculated. The influence of moisture on the thermal conductivity of glass fiber insulant was studied experimentally in three ways: with measurements using a transient method; with heat flow measurements in steady-state conditions; and with heat flow measurement in natural climate. All the three approaches gave for thermal conductivity a nearly linear function of moisture content. It can be shown theoretically, that the heat pipe effect inside insulating material may, however, cause a drastic increase in the apparent thermal conductivity. The requisites for the heat pipe effect are saturation conditions and the return of condensed moisture to the "hot" surface of the structure or the test apparatus. In practice, this does not occur very often. According to the computer simulations the energy needed to dry out the construction-time moisture may be significant compared with the heat losses due to pure heat conduction. In most cases the influence of diffusion moisture transfer on heat transfer is not significant. It is suggested that the U-value of a wet structure should be based on the time-integrated heat flux and surface temperature difference of the structure: with numerical simulation it is possible to determine the influence of moisture on the thermal resistance of different kinds of structures in different hygrothermal loading conditions, provided that we have available a normalized simulation model and the corresponding material data and the loading conditions (weather data).

3202 Transportation

REFER ALSO TO CITATION(S) 14709, 15555, 15948

14836 (CONF-870564—7) Racial and demographic differences in household travel and fuel purchase behavior. Gur, Y.; Millar, M. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003126/JAW.

From Socioeconomic energy research and analysis conference; Washington, DC, USA (21 May 1987).

Monthly fuel purchase logs from the Residential Energy Consumption Survey's Household Transportation Panel (TP) were analyzed to determine the relationship between various household characteristics and purchase frequency, tank inventories, vehicle-miles traveled, and fuel expenditures. Multiple classification analysis (MCA) was used to relate observed differences in dependent variables to such index-type household characteristics as income and residence location, and sex, race and age of household head. Because it isolates the net effect of each parameter, after accounting for the effects of all other parameters, MCA is particularly appropriate for this type of analysis. Results reveal clear differences in travel and fuel purchase behavior for four distinct groups of vehicle-owning households. Black households tend to own far fewer vehicles with lower fuel economy, to use them more intensively, to purchase fuel more frequently, and to maintain lower fuel inventories than white households. Similarly, poor households own fewer vehicles with lower fuel economy, but they drive them less intensively, purchase fuel more frequently, and maintain lower fuel inventories than non-poor households. Elderly households also own fewer vehicles with lower fuel economy. But since they drive them much less intensively, their fuel purchases are much less frequent and their fuel inventories are higher than nonelderly households. Female-headed households also own fewer vehicles but with somewhat higher fuel economy. They drive them less intensively, maintain higher fuel inventories, and purchase fuel less frequently than male-headed households. 13 refs., 8 tabs.

14837 (DOE/PE—0078) Oil use and oil dependency in the US economy. (USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC. Office of Policy Integration). Dec 1987. 23p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005073/JAW.

This analysis addresses the flexibility of one component of the economy's possible response to an oil supply disruption/price increase - the direct technical capability for substitution of other fuels for oil in the US economy over the short run (1 to 2 years). While it is clear that the economy will respond to changes in the oil market in a wide variety of ways, this paper is focused on what we believe to be, in terms of vulnerability, the more important short-term response of substituting other fuels for oil. Other responses of the economy, such as increased equipment efficiency, changing fuel-using equipment, or decreased demand for oil-based goods are mostly longer term and beyond the scope or purpose of this work. Fuel switching is also important because it can reduce oil use with less economic damage than reductions in demand due to a loss of economic output. The paper has three sections. The first section reviews changes in historical oil consumption patterns. The second section presents an analysis of oil consumption data and identifies the oil consumption and dependence of particular sectoral energy end-uses. The third section concludes with a summary of oil use and oil dependence, and their implications for US energy security.

14838 (NP—8751686) Introduction of computer-aided driving dynamics for optimising the energy demand in local railways. Biella, W. (Technische Univ. Berlin (Germany, F.R.). Fachbereich 19 - Elektrotechnik). 1986. 15p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751686/JAW.

The possibilities of optimising the energy consumption for a train journey between two stops are known from the literature. These include regenerative braking and the introduction of a free-wheel phase in train travel. The timetable of a local railway consists of fixed driving and stopping times, so that only the driving time reserves can be used for a train travel with freewheel. A considerable expansion of the driving time can only be achieved by introducing driving dynamics. The report gives a survey for using energy-saving driving with freewheeling. In this connection, the importance of driving dynamics is made clear, whose sensible use assumes the use of train computers. The introduction of computer-aided driving dynamics as the main point of continued investigations shows new possibilities for reducing the traction energy.

14839 (PB—88-120662/XAB) Off-peak use of the Houston transitway system. Research report, September 1984-March 1987. Mounce, J.M.; Stokes, R.W. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Mar 1987. 56p. (TTI—2-10-85-484-5). NTIS, PC A04/MF A01.

The intent of the study was to identify and evaluate possible off-peak uses of the Houston transitway system by vehicles other than authorized HOV's. Based upon the information available at the time of the report and the analyses conducted herein, it is recommended that off-peak utilization of transitways be continued for high-occupancy requirements. It is recognized that during off-peak periods, the cost of operation currently exceeds any delay savings or other benefits. However, with increasing congestion, the HOV transitway user demand will increase, and current facility designs can serve future demands.

14840 (PB—88-120670/XAB) ULI/UMTA (Urban Land Institute/Urban Mass Transportation Administration) Policy Forum of Joint Development of Rail-Transit Facilities. Dunphy, R. (Urban Land Inst., Washington, DC (USA)). 1987. 115p. NTIS, PC A06/MF A01.

Proceedings of a conference held at Washington, D.C. on June 11-12, 1986. Library of Congress catalog card no. 87-82098.

The ULI/UMTA Policy Forum on Joint Development of Rail Transit Facilities convened June 11-12, 1986. The participants included a representative group of developers, transit operators, local government officials, lenders, and public-interest groups concerned with transportation and urban development. Workshops at the forum elicited a consensus that UMTA should establish policies to advance, support, and reinforce joint development. They also recommended development of a set of guidelines that would address zoning and planning for density and traffic problems. It was also recommended that land-use changes at, near, or on development sites need to be made before construction begins, in part to preclude parties involved from changing their minds. The report includes general session presentations on the Hong Kong and Dulles DART projects, workshop summaries, and resource papers presented.

14841 (PB—88-122510/XAB) Hot-mix recycling evaluation in Washington. Final report. Peters, A.J.; Gietz, R.H.; Walter, J.P.; Damitio, J. (Washington State Dept. of Transportation, Olympia (USA)). Dec 1986. 41p. (WA-RD—98.1). NTIS, PC A03/MF A01.

See also PB—88-122528.

The Washington State Department of Transportation (WSDOT) has completed construction of twenty-four hot-mix recycle projects as of January, 1985. At the beginning of the study there were sixteen completed projects that were to be examined. Evaluation of the laboratory and pavement performance data shows that WSDOT's initial two projects, Renslow to Ryegrass (1977) and Yakima River to West Ellensburg Interchange (1978), are still performing very well. Although the other fourteen projects have been constructed only within the last two and a half years, the early data indicates equally promising results. Because of the impressive pavement performance exhibited by the recycled pavements, together with hot-mix recycle benefits such as conservation of natural resources, feasibility of construction, and its cost advantage over new ACP, hot-mix recycling has become an attractive addition to the WSDOT paving program.

14842 (PB—88-122528/XAB) Hot-mix recycling evaluation in Washington: Appendix - project evaluations. Final report. Peters, A.J.; Gietz, R.H.; Walter, J.P. (Washington State Dept. of Transportation, Olympia (USA)). Dec 1986. 188p. (WA-RD—98.2). NTIS, PC A09/MF A01.

See also PB—88-122510.

The Washington State Department of Transportation (WSDOT) has completed construction of twenty-four hot-mix recycle projects as of January, 1985. At the beginning of the study there were sixteen completed projects that were to be examined. Evaluation of the laboratory and pavement performance data shows that WSDOT's initial two projects, Renslow to Ryegrass (1977) and Yakima River to West Ellensburg Interchange (1978), are still performing very well. Although the other fourteen projects have been constructed only within the last two and a half years, the early data indicates equally promising results. Because of the impressive pavement performance exhibited by the recycled pavements, together with hot-mix recycle benefits such as conservation of natural resources, feasibility of construction, and its cost advantage over new ACP, hot-mix recycling has become an attractive addition to the WSDOT paving program.

14843 **(TEMP—87/01) TEMP year-end report. Part 1: conservation and marketing: fiscal year, 1986/1987.** (Transportation Energy Management Program, Downsview, Ontario (Canada)). Sep 1987. 44p. (MICROLOG—87-05954). Transportation Energy Management Program (TEMP), Central Building, Rm. 324, Ontario Ministry of Transportation and Communications, 1201 Wilson Ave., Downsview, Ont., Canada' M3M 1J8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Transportation Energy Management Program (TEMP) is a joint program of the Ministry of Transportation and Communications and the Ministry of Energy aimed at reducing Ontario's oil consumption in the transportation sector. It has operated in the two sections: Conservation and Marketing, administered by the Transportation Energy Office, and Alternative Transportation Fuels, administered by the Automotive Technology and Systems Office. This report details the subprograms of Trucksave, DriveSave, a municipal program, government programs, and the Alternative Transportation Fuels marketing program. 7 tabs.

14844 **(VTT-TUTK—380) Emergencies in the overland transportation of hazardous materials.** Pipatti, R.; Lautkaski, R.; Fieandt, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Mar 1985. 111p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751093/JAW.

The purpose of the project was to produce practical information on hazards associated with the overland transportation of hazardous materials. The project was based upon surveys made by the Ministry of Traffic and the Finnish State Railways on transportation of hazardous materials by road and rail in 1982. The most important materials were listed according to the ARD/RID-classification completed with three hazard classifications. Major changes in transportation of hazardous materials since 1982 were considered. Descriptions of 79 accidents involving hazardous materials were taken from both domestic and foreign professional periodicals. Conclusions on factors that lead to the accidents and on typical damage modes of the transportation containers were made on the basic of these descriptions and foreign surveys. The most important potential hazards during transportation were classified according to the primary causes. The classification was based on the accident reports and the properties of the materials. Evacuation distances were estimated for leakages of toxic gases, liquefied petroleum gases, volatile liquids and bleves. Decision-making and mitigation techniques at hazardous materials incidents were reviewed along with the need for personal protection and special equipment.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 13970, 13972, 14005, 14118, 14415, 14456, 14776, 14837, 14896, 15573

14845 **(BFR-R—841232-9) Investigation of the potential of industrial waste gas. Gas from organic raw materials produced by fermentation or pyrolysis.** Norbaeck, K. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 21p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751141/JAW.

This project emanated from a wish to be able to make use of industrial waste gas which at present is merely flared off. It was natural to start the work with a country-wide general survey of such combustible gases. From here, it was but a short step to ascertain the potential available from fermentation or gasification of organic energy raw materials. All likely industries in the country have been asked about their waste gas potential. As far as biogas from organic energy raw materials is concerned, the position is such that it is not always necessarily the case that a combustible gas is the only alternative. The following potentials have been ascertained: (TWh/year) Straw from present-day agriculture 10, Manure from present-day animal quarters 0.6, Energy crops 20, Algae cultivation 10-15, Effluent treatment plants 0.16, Gas from tips 1, Chemical waste from the forest industry 0.1, Forest fuels (excl industrial liquors) 30-60, Energy forests 80-160, Peat >30. The table clearly shows which energy raw materials could be significant. Present day utilization of combustible gases from these sources is negligible.

14846 **(BMFT-FB-T—86-221) Integrated use of waste heat from steel mill, rolling mill and forging. Final report.** Baettenhausen, N. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Edelstahlwerke Buderus A.G., Wetzlar (Germany, F.R.)). Dec 1986. 29p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751662/JAW.

The aim of the project is to reduce the high consumption of energy in a more heating production procedure of heavy forgings to a minimum. Apart from that the integration of various sources of waste heat working on a consumption system was tested. The whole equipment consisting of five waste heat sources and a consumer has been working since October 1981. According to the test results it answers our expectations. The amount of recovered waste heat of the total consumption could be increased to 65%. These results show that a complex system of waste heat consumption consisting of different waste heat sources and a heat consumer who cannot be influenced can work at the highest level concerning the automatic control technology, the consumption of energy and the economic point of view. With 5 figs..

14847 **(CONF-871204—3) Opportunities for improved energy recovery in pulp mills.** Compere, A.L.; Griffith, W.L.; Joyce, T.W. (Oak Ridge National Lab., TN (USA); North Carolina State Univ., Raleigh (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A03. Order Number DE88005068/JAW.

From 8. Miami international conference on alternative energy sources; Miami Beach, FL, USA (14 Dec 1987).

Material, capital, and energy costs for the production of neutral solvents using conventional petrochemical technology and pulp stream fermentations were compared. Embodied energy and capital costs for the fermentation method were sharply lower than those for the conventional petrochemical process. The major reasons for energy conservation are the use of innovative separations technologies and the ability to make more effective use of conventional technologies, such as multiple-effect evaporation. Pulp and paper mills present an excellent opportunity for fermentation technologies in that their biomass streams are collected, sterile, and hot. Use of mill-integrated fermentation technologies could provide nearly 5 x 10^{14} Btu (0.5 PJ) of premium chemicals while providing industry with extremely short payback periods, possibly on the order of a few months.

14848 (CONF-8703206—, pp 117-143) **Industrial production, preventing emission and treating residues as a combined task.** Eickelpasch, D. (Hoesch Huettenwerke A.G., Dortmund, Germany, F.R.). 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751688/JAW.

From 30. anniversary of the VDI Commission on air pollution prevention; Duesseldorf, F.R. Germany (17 Mar 1987).

Schriftenreihe der VDI-Kommission Reinhaltung der Luft.; v. 6.

The lecture shows the principle, using historical examples, on which environmentally acceptable production has to work. These principles are: Measuring harmful substances as well as possible, separating them as much as possible, recirculating separated

material, depositing material which cannot be recirculated, and removing material which cannot be separated from the environment by dilution.

14849 (DOE/CE/40545—20) Diagnosis of sources of current inefficiency in industrial molten salt electrolysis cells by Raman spectroscopy: A topical report on chlorides: Topical report, June 1982-June 1987. Sadoway, D.R. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1987. Contract FG07-82CE40545. 191p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88005025/JAW.

Contains thesis by Seok-Yeol Yoon: A spectroelectrochemical study of aluminum and magnesium electrolysis in molten chlorides.

Molten salt electrolysis, a very energy-intensive process, is used in the extraction of light metals. Aluminum production by the Hall process and magnesium production in the Dow and I.G. Farbenindustrie cells constitute the major commercial applications of metal electrowinning from molten-salt media at present. The energy input into the electrolysis cell is in the form of direct current, and the energy efficiencies in the magnesium or aluminum processes are only in the 30 to 40% range. Major energy reductions are achieved by reducing the cell voltage or by increasing the current efficiency. Goal of the research is to identify the sources of the current losses occurring in molten salt electrolysis. This research worked on the systems of I.G. Farben magnesium chloride and Alcoa smelting aluminum chloride processes. Raman spectra were measured and analyzed for each component or their mixtures of the electrolyte for magnesium and aluminum reduction in chloride melts. Raman measurements were also conducted on the melts of industrial composition for aluminum and magnesium electrolysis. In laboratory-scale cells which imitated industrial practice, Raman spectra were measured in situ during electrolysis in attempts to identify the streamers, coloration of electrolyte, and any subvalent species. They were known to occur only during electrolysis, and they have been reported to be possible current losses. Cyclic voltammetry was conducted to obtain information about the generation of subvalent species which were not detected by Raman measurement. These were thought to be kinetic entities present only during electrolysis. Results of Raman spectroscopy and electrochemistry of magnesium and aluminum reduction from molten chloride bath are presented. The results would be useful to establish the basis for the study of electrolysis of aluminum from molten fluoride media. 119 refs., 66 figs.

14850 (DOE/CE/40699—T7) Energy management assistance for small and medium-size manufacturers: An evaluation of EADCs' performance in manufacturing plants, 1986-1987. Kirsch, F.W. (University City Science Center, Philadelphia, PA (USA). Center for Energy Management and Industrial Technology). Dec 1987. Contract FC01-84CE40699. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004588/JAW.

Small and medium-size manufacturers served by the Energy Analysis and Diagnostic Center (EADC) program are interviewed periodically to reveal how well the EADCs carried out their responsibilities. These structured interviews enable the engineering staff who manage the program to learn how well the EADCs did their work in these plants and how effectively they reported the results. This report presents the results of interviews conducted during the 1986-87 program period at the plants of 175 manufacturers served by nine EADCs located between New England and Colorado.

14851 (DOE/RL/01830—T56) The US textile industry: An energy perspective. Badin, J.S.; Lowitt, H.E. (Energetics, Inc., Columbia, MD (USA)). Jan 1988. Contract AC06-76RL01830. 254p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88005312/JAW.

This report investigates the state of the US textile industry in terms of energy consumption and conservation. Specific objectives were: To update and verify energy and materials consumption data at the various process levels in 1984; to determine the potential energy savings attainable with current (1984), state-of-the-art, and future production practices and technologies (2010); and to identify new areas of research and development opportunity that will enable these potential future savings to be achieved. Results of this study concluded that in the year 2010, there is a potential to save between 34% and 53% of the energy used in current production practices, dependent on the projected technology mix. R&D needs and opportunities were identified for the industry in three categories: process modification, basic research, and improved housekeeping practices that reduce energy consumption. Potential R&D candidates for DOE involvement with the private sector were assessed and selected from the identified list.

14852 (ECRC/M—2218) How to save energy through improved insulation of the coreless furnace coil. Wilford, C.F. (Electricity Council Research Centre, Capenhurst (UK)). Nov 1987. 20p. Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.

The energy benefits from incorporating thermal insulation in the walls of a mains frequency coreless furnace are examined together with the reasons for the choice of insulating material. Thermal and electrical results obtained from trials on three industrial furnaces are described, the work being done in conjunction with BCIRA as the monitoring organisation and linked to an energy efficiency demonstration scheme which is managed by ETSU on behalf of the Energy Efficiency Office. It was found that the use of thermal insulation in all three furnaces was advantageous, although excessive insulation had to be avoided. The advantages arose from a reduction in thermal flux through the lining together with an improvement in the electrical efficiency of the induction coil. This electrical effect was unexpected and is under further investigation.

14853 (EEO-ED—139/162) Use of energy management systems in a group of bank branches. A demonstration at Barclays Bank (London). (Department of Energy, London (UK). Energy Efficiency Office; ERA Technology Ltd., Leatherhead (UK)). Jul 1987. 20p. British Library Document Supply Centre,, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Energy Efficiency Demonstration Scheme final report for The Energy Technology Support Unit (ETSU), Harwell (GB).

Annual savings of Pound 60,200 have been realised by Barclays Bank Plc as a result of the installation of an energy management system (EMS). In an attempt to reduce energy costs, Barclays Bank introduced an EMS covering 50 of their buildings, all of which were within a 50 mile radius of central London. The new EMS equipment is of the distributed intelligence type with standalone controllers (outstations) in each branch. The outstations communicate with a central supervisory unit via the public telephone network using two-way auto dialling. All of the control parameters that can be changed on the front panels of the individual branches, ie internal temperature set point and start/stop times for each day of the week, can now be changed and monitored remotely from the central station. The installation of the new system has achieved substantial annual energy savings for a capital cost of Pound 358,000.

14854 (GB—118) Heat recovery from high temperature waste gas streams. Gettings, M. (Department of Energy, London (UK). Energy Efficiency Office; UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Jun 1987. 70p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751839/JAW.

The energy lost every year by UK industry in hot waste gas streams is equivalent to the burning of about nine million tonnes of coal (Mtce). Most of these hot waste gases are generated from kilns, ovens and furnaces. Along with labour and materials, energy represents a direct cost to industry and thus improving its utilisation will have a direct positive influence on profit margins. A simple guide to the implementation of heat recovery projects, based on examples found in the Energy Efficiency Demonstration Scheme is presented. It is intended to be useful to both technical and non-technical staff involved in furnace, oven or kiln management and process control and concentrates on the measures possible to recover waste heat from gases at temperatures > 400/sup 0/C.

14855 (LITH-IKP-R—414) Energy measurement at a slaughterhouse. Johansson, T. (Linkoeping Univ. (Sweden). Dept. of Mechanical Engineering). 1984. 39p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751135/JAW.

Waste heat flows have been investigated at a slaughterhouse, as a base for evaluating the potential for waste heat based short time heat storage in industry. (L.E.).

14856 (LITH-IKP-R—415) Energy measurements at a textile preparation plant. Johansson, T. (Linkoeping Univ. (Sweden). Dept. of Mechanical Engineering). 1985. 42p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751136/JAW.

Energy flows at a textile processing plant have been studied in order to map the potential for waste heat based short time heat storage. (L.E.).

14857 (LITH-IKP-R—416) Energy use in wood drying. Johansson, T. (Linkoeping Univ. (Sweden). Dept. of Mechanical Engineering). 1985. 22p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751137/JAW.

Energy use for drying at sawmills has been studied in order to map the potential for waste heat based short time heat storage in industry. (L.E.).

14858 (NEI-DK—52) Technical requirements to the desulfurization products used in industry. Agersted Nielsen, K.; Gram Jeppesen, K. (Danmarks Tekniske Hoejskole, Lyngby. Inst. for Mineralindustri). Apr 1986. 40p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751082/JAW.

The aim of the project was an investigation in the possibility of utilization of the products from Flue Gas Desulphurization by industry. Investigation of literature and experiments with desulphurization gypsum used for plate production proved desulphurization gypsum to be usable. In mixtures 3:1 with natural gypsum it is possible to achieve significant increased strength. Investigation in literature and model experiments concerning reaction of tricalciumaluminate with water and sulphite showed the possibility of formation of Afm-phase. Substitution of about 10% by spray-drying absorption products containing fly ash showed low strength immediately after mortar casting (according to the DS 427), but after storing in water for three months the strength was almost normal. There was no indication of expansion. Investigation of the retarding effect of calcium sulphite according to DS 427 was negative. A revised procedure by determination of water requirement showed, that calcium sulphite and spray drying product had satisfactory effect as retarder. The same procedure was applied for casting mortars containing the dry product and gave high early strength. (EG). 43 refs., EFP-85.

14859 (NEI-FI—30) Applications and profitability of heat pumps using hood exhaust air as a heat source. Eriksson, K.; Maenty, J.; Karlsson, M. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Jan 1987. 127p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751178/JAW.

The purpose of this study was to find out the applications and profitability of heat pumps using hood exhaust air as a heat source. The potential of the paper machine heat pumps in Finland and in Sweden was estimated on the basis of the obtained results. Altogether three different applications of the heat pumps were studied: the heating of the supply air, the production of steam and the heating of the short circulation in the paper machines. In every application both compression and absorption heat pumps were studied. The performance of the compression heat pumps was calculated by the help of two simultion programs which were created during this study. The installation of a heat pump in a paper mill which has a power plant of its own always affects the production of both steam and electricity. Therefore the heat pumps were studied as a part of the whole energy system in order to find out the real savings in energy costs. The price of fuel and electricity has a great effect on the profitability of the heat pump applications. The low price of peat and coal and the collapse of the price of oil have made heat pump investments unprofitable nowadays (January, 1987). In Finland where the price of electricity is around 160 mk/MWh the price of fuel must exceed 70 mk/MWh before the heat pump is a profitable investment at leat theoretically. To have realistic possibilities to cope with the other forms of energy production the heat pumps generally require fuel prices of over 80-90 mk/MWh.

14860 (NEI-FI—31) Gas turbines in mechanical pulp production. Niemi, A. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Apr 1987. 44p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01 . Order Number DE88751179/JAW.

Mechanical pulp production increases all the time which causes growth in electric power demand. The growth could be reduced by using combustion engines or gas turbines instead of electric motors. Gas turbines may be mechanically at least as suitable as gas-diesel engines to drive thermomechanical pulpers or pressure grinders. The torque curves of gas turbines show that starting is easier than when using diesels. Which one is economically better - a gas turbine or a diesel - must be solved case by case. It depends essentionally on whether all the recoverable heat of a diesel engine can be used. In a diesel one part of the waste heat is recovered as low pressure steam and another part as hot water; in a gas turbine all the recovered heat is steam. In industry it is easier to find use for steam than for hot water. In example case, the payback period of a new gas turbine driven TMP or PGW was 3.1 years compared to an electric motor driven utility. The potential capacity of gas turbine driven production of mechanical pulp will be 405000-855000 t/a by the year 2000, which would mean a decrease of 120-250 MW in the growth of electric power demand. The investment cost of a coal power plant is about 4400 FIM/kW, while the price of a gas turbine with a mechanical drive is about 1880 FIM/kW. The increase in mechanical power demand would therefore be 330-680 million FIM cheaper when using gas turbines than if a coal power plant would be built and electric motors installed. The use of gas turbines would decrease the rise in raw energy consumption by 0.3-0.7% of the total energy consumption in Finland in 1986. The imports of hard coal would decrease by 5-12% and the imports of natural gas would increase by 10-22% compared with the import statistics of the year 1986.

14861 (NEI-FI—32) Connection of a gas turbine to a recovery boiler. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). May 1987. 47p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751176/JAW.

The study examines various alternatives to connect a gas turbine to a recovery boiler and in this way to increase production of back-pressure electricity of the woodprocessing plant. The calculations made showed that in this case it is not technically feasible to use the gas turbine exhaust gas at a temperature of about 510 deg C directly as combustion air of a recovery boiler. The amount of inert gas rises and in spite of the energy content of the hot exhaust gas led to the boiler, the combustion temperature in the recovery boiler will decrease and the conditions for stable combustion will deteriorate. It is possible to improve combustion conditions by increasing the dry solids content of black liquor and at the same time the heat value with a socalled superconcentrator or by preheating the combustion air of the recovery boiler with the exhaust gas of the gas turbine to a temperature of 400 deg C. Taking into account technical and economic points, however, the most recommendable alternative in the subject case is a gas turbine and a separate waste heat boiler, in which case exhaust gases would not be led into the recovery boiler. On On the other hand, the transfer of external fuels of the woodprocessing mills from the process or power boiler to a separate gas turbine - waste heat boiler plant is economical at present prices compared with, for instance, the building of a new condensing power plant. In the area of the present natural gas pipeline, the application potential of the above principle is more than 500 MW additional power, during a time period of 10-20 years, i.e. the time of natural renovation of the units. An average price of additional electricity with a service time of 20 years and with a real interest rate of 5% will be FIM 105-135/MWh when the price of gas is FIM 50/MWh. If the gas turbine is realized before the end of

the service life of the existing boiler capacity, the price for electricity will be FIM 160-200/MWh.

14862 **(NEI-FI—33) Operation of supercondentrator and superburning.** Vaistomaa, J.; Uppstu, E.; Ojala, S.; Kaerki, R. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Jun 1987. 22p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751177/JAW.

A new type of evaporator has been developed by Rosenlew Engineering to concentrate black liquor to a very high solids content of 75-80%. At the same time Tampella boiler division has developed equipment to burn black liquor at a very high solids contents. Mill-scale trials were conducted in the Aittaluoto kraft pulp mill a capacity of 80000 tons unbleached pulp a year. The test trials were carried out and the results were analysed and reported by EKONO. The following benefits could be discovered during the test trials: Steam production in the recovery boiler increased with 9-12% per ton dry solids when the solids content was increased to 75-80%, Sulphur dioxide emissions decreased from abut 150-200 ppm to 0, The consumption of soot-blowing steam decreased about 30%, The operation of the recovery boiler became easier. There are only a few disadvantages. The most important one is a slight increase in the fly ash flow before and after the electrostatic precipitator.

14863 **(NP—8751696) Investigations on the use of plastic waste mixtures as a source of energy.** Kohaupt, U. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Aufbereitung, Kokerei und Brikettierung; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Feb 1987. 20p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751696/JAW.

The following circumstances were found in the context of this research project on the use of old plastic as an energy source in the cement industry: Plastic foil has a chlorine content of 2.7% which can be reduced to a content of less than 1.3% by separating certain large areas of foil, Excluding PVC packing foil, according to a recommendation of the West German Health Office, leads one to expect a further reduction of the chlorine content. Cutting up in mills must be regarded as the optimum with regard to the necessity for pneumatic transport in the cement works. For economic reasons, the foil material should be transported to the cement works whole and compressed into bales and only be cut up there. A basic requirement to reduce the chlorine content of the substitute fuel can be fulfilled by the exclusive use of sorted plastic foil waste. One has to do without the high energy content of about 28% of plastic waste in the form of polyolefin and polystyrene. After the development of a cheap sorting process, one can expect a new market for old plastics in the field of process heat.

14864 **(NP—8751704) Investigations on novel air heat exchangers for energy economization by improving heat recovery. Final report.** Zilkenath, W.; Scheruhn, H. (Hannover Univ. (Germany, F.R.). Inst. fuer Kerntechnik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1985. 91p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751704/JAW.

1. State of the art: Heat transfer in finned heat exchangers. 2. Objective: Optimized design of novel heat exchangers with air flow inside the tubes to improve heat recovery and energy economization compared by outside finned tubes. The influence of the tube geometry and corrugation geometry (distance, form and height of the corrugation) upon heat transfer and flow resistance has to be investigated. 3. Methods: a) Installation of a single tube and a tube bundle test plant. b) Experimental study of parameters dependent on the tube- and corrugation geometry. c) Derivation of an empirical equitation to evaluate the thermohydraulic datas. 4. Results: For the ratio of aperture of corrugation a maximum of heat transfer performance dependent on the ventilator performance was found. 5. Conclusion/potential of applications: Since the thermal resistance of the fin has not to be considered, it is possible to use tube materials with low thermal conductivity, but a high corrosion barrier (chemical industry, chemical engineering, energy economization). With 12 refs., 3 tabs., 54 figs..

14865 **(NYSERDA—87-25) Feasibility of using a waste-heat-driven lithium bromide refrigeration system: Final report.** DeFrees, J.A.; Amberger, R.F.; O'Shea, R. (RIT Research Corp., Rochester, NY (USA)). Nov 1987. 69p. NYSERDA, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI88900304/JAW.

This report describes the feasibility of combining new, lithium bromide absorption equipment with existing mechanical vapor-compression refrigeration machines to create a multi-stage refrigeration system. Steam, derived from the exhaust of a turbine generator set, would be used as the thermal input to the absorption machine. Chilled water produced in the absorption machine would be used in a condenser into which one compressor discharges refrigerant. A substantially reduced condensing pressure could be maintained. Savings would result from the reduction in energy required to power the refrigerant compressor and the additional electricity which can be generated as a result of the increased steam demand. A 32% return on investment was calculated.

14866 **(OUP—87-32) Solar energy for a hot air dryer at the Lie farmstead in the county of Flesberg.** Andersen, S.L.; Espe, I.; Herbjoernsen, O.; Lie, O.; Mehlen, M. (Oslo Univ. (Norway). Fysisk Inst.). Dec 1987. 41p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751207/JAW.

The report deals with an evaluation of a grass hot-air dryer for a farmstead in the county of Flesberg (Norway). The dryer is equipped with solar collectors. The design, operation conditions, measuring methods and initial- and working expenses are presented. The various operation depending conditons such as humidity, temperature and solar radiation and wind are recorded and discussed. 31 drawings.

14867 **(PB—88-854286/XAB) Industrial-heating technology. August 1983-December 1987 (citations from the Engineering Index data base). Report for August 1983-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 71p. NTIS PC N01/MF N01.

Supersedes PB—86-855202.

This bibliography contains citations concerning the design, development, and application of industrial-heating technology. Solar, oil, gas, electrical, and microwave systems in industrial applications are discussed. (This updated bibliography contains 161 citations, 95 of which are new entries to the previous edition.)

14868 **(STF—11A87004) Evaluation of air source heat pumps for root zone heating in greenhouses.** Aune, E. (SINTEF, Trondheim (Norway)). Feb 1987. 18p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751222/JAW.

The report deals with evaluation of pilot plant for the heating of root zones and liquid manures in acryl-glazed greenhouses. The plant consists of a closed cycle piping equipped with an air source heat pump, heat accumulator, oil-fuelled boiler, heat exchanger for the heating of liquid manures, and control valves and systems. 9 drawing.

14869 **(STF—15A86029) Glass roof with enclosed air-conditioning plant.** Harsem, T.T. (SINTEF, Trondheim (Norway)). May 1986. 45p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751127/JAW.

The report deals with a simulation on the energy consumption and absorbed energy from solar absorbers in connection with a new-designed glass roofing with air-conditioning systems in greenhouses. The simulation is done with the references to various areas by means of the computer program Royal-DEBAK. 26 drawings, 14 tables.

14870 **(STF—15A86040) Pellet firing.** Johnsen, D.S.; Karlsvik, E. (SINTEF, Trondheim (Norway)). Aug 1986. 25p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751129/JAW.

The report concerns an investigation together with test results for two types of combustors both in insulated and uninsulated

chambers. The preliminary test results for pellets, chips and briquettes are given. The chemical analyses of slag together with a literature study of slag formation from the firing of pellets are presented. The results from the practical experiments, analyses and literature studies are mentioned, and evaluations are given. 2 drawings, 5 tables.

14871 (STF—48A86016) Supervision of fouling in heat exchangers. Berg, S. (SINTEF, Trondheim (Norway)). Aug 1986. 52p. (In Norwegian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751123/JAW.

The report deals with fouling supervision methods for the evaporation equipment in the calcium nitrate plant at Porsgrunn Fabrikker, Norsk Hydro A/S. The fouling in thermo-technical equipment entails increased heat- and flow resistance. A literature study on different types of fouling and mechanisms is presented. On the basis of recorded values from the process, the various fouling thicknesses in tubular heat exchangers are calculated by means of the computer program Wilsonplot. A sensitivity analysis shows that the various process temperatures influence the rated results. 13 drawings, 3 tables, 27 references.

14872 (VTT-TIED—694) Cogeneration of electricity and heat in industry. ElMahgary, Y. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). May 1987. 64p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751105/JAW.

The overview was prepared for the United Nations Environment Programme (UNEP). It represents one of the five parts forming UNEP's comprehensive study on cogeneration of electricity and heat in developing countries. The other parts of the study deal with cogeneration in district heating and cooling, cogeneration in fresh water production and other applications of waste heat. The publication consists of a short revision of the principle of cogeneration cycles, which in spite of their tremendous potential for energy conservation and environment protection, are still almost unknown to the majority of developing countries. It is followed by selected examples of modern utilization of cogeneration in industry. These are given in some detail with emphasis on the industries of particular interest to developing countries. The use of alternative fuels in cogeneration, particularly non-commercial fuels, like rice hull, wood and agricultural wastes, slurry, etc., is of particular importance in developing countries. For this reason examples of most recent applications of cogeneration using alternative fuels are discussed. This is followed by consideration of the economic and social aspects of cogeneration. Finally, a few conclusions and general guiding steps suggested for developing countries interested in cogeneration are given.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 14382, 14455, 14592, 14593

14873 (ANL—87-21) Assessment of impact of advanced energy transmission fluids on district heating and cooling systems (Phase 1). Kasza, K.E.; Chen, M.M. (Argonne National Lab., IL (USA)). Sep 1987. Contract W-31109-ENG-38. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001589/JAW.

Argonne National Laboratory (ANL), under sponsorship of the US Department of Energy (DOE) Office of Buildings and Community Systems, has embarked upon a comprehensive, long-range program to develop high-performance advanced energy transmission fluids for use in district heating and cooling (DHC) systems. ANL has the lead technical role in this DOE program. These advanced fluids will substantially reduce flow frictional losses and enhance energy transfer. In system enhancement scoping studies conducted by ANL, the fluids yielded potentially significant upfront capital equipment cost reductions by allowing the use of smaller pipes, pumps, heat exchangers, and storage tanks as well as reductions in operational costs. This report presents the first-phase results of assessment of impact of the advanced fluids on DHC systems. Future reports will focus on assessment of impact on hardware performance, capital eqiupment, and operation costs. 9 refs., 30 figs., 2 tab.

14874 (DOE/CE/26548—T1) Assessment for the expansion of the Grand Rapids district heating and cooling system. (Karnitz Associates, Inc., Knoxville, TN/Scantec, Inc., and FVB District Heating, Inc., St. Paul, MN (USA)). 18 Nov 1987. Contract FG01-86CE26548. 142p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88004918/JAW.

New district heating and cooling areas are identified for Grand Rapids, Michigan. The district heating and cooling concept is assessed from the perspective of meeting economic development objectives through the application of cost effective expansion of the existing system. The assessment includes identification and characterization of potential service areas, supply options and distribution options, and specific potential district heating and cooling projects, and assesses their technical, economic, marketing, institutional and financial feasibility. The existing steam district heating system is reviewed, including an assessment of the potential for new customers in the existing service area. Two specific district heating and cooling customers in the existing service area. Two specific district heating and cooling projects are assessed. The development of a new hot water and chilled water system to serve a new East Bank Development is outlined, as well as the development of hot water system for the Heritage Hill area. A ten year expansion plan for developing the district heating and cooling system is described. (LEW)

14875 (NEI-DK—56) Demonstration project Vester Nebel. Final report. Lange, M. (Esbjerg Kommune (Denmark). Forsyningsvirksomhederne). Oct 1987. 58p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751146/JAW.

The demonstration project at Vester Nebel is a combined collective heat supplying system. The plant has the purpose of demonstrating the possibilities of using renewable energy sources for collective heat supply in smaller communities. 97 buildings, mainly single-family houses, are connected to the plant. The production of heat comes from solar collector, heat pump, straw-fueled boiler, oil-fueled boiler and wind turbines. Heat supply to the heat pump is mainly produced by solar energy. The operation of the heat producing units is that the solar collectors are not connected to the other units. The heat pump starts when the solar collector is not producing enough, then the strawfueled boiler starts, and when all these cannot sustain the supply, the oil-fueled boiler is used as peak load. The system has as a whole been very reliable, exept that the heat loss in the distribution system has been 25%, which is higher than the expected 13%. (SM). 10 refs.

14876 (NEI-NO—16) Energy, environment, economy. Wastes - a resource. (Norsk Bioforum). 9 Dec 1986. 87p. (In Norwegian). (CONF-8612116—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751113/JAW.

From Seminar on utilization of energy and biogas from waste deposits; Sandefjord, Norway (9 Dec 1986).

The seminar discusses the following aspects concerning energy recovery from landfills: 1) Enhancement techniques for landfill gas production 2) Processed fuels from wastes 3) Increased importance of landfill gas 4) Landfill gas-research and development 5) Gas permeability of landfills 6) Long-term costs for firm power. Separate abstracts are prepared for two lectures of the conference.

14877 (PB—88-138177/XAB) Guide to energy from municipal waste for small communities. Richards, D.; Burgher, B. (JRB Associates, Inc., McLean, VA (USA)). Oct 1982. 117p. NTIS, PC A06/MF A01.

Energy recovery is emerging as a viable solid-waste-management alternative for many smaller communities in the United States; however, implementation of such projects requires considerable investment in front-end planning and development, which many municipal officials cannot make while significant doubts exist as to the suitability of the solid-waste-management alternative for their communities. The objective of this guide is to provide these officials with the means to perform a preliminary assessment of the feasibility of energy recovery with a minimum amount of effort and cost. The guide is intended for communities with populations ranging from approximately 30,000 to 200,000. The technology discussed in the document is limited to the consideration of modular incine-

ation, which is generally the most-appropriate technology for small communities.

14878 (STF—11A86043) Heat pump development plan for the county of Soer-Troendelag. Eggen, G.; Norstein, S. (SINTEF, Trondheim (Norway)). Oct 1986. 59p. (In Norwegian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751225/JAW.

The report discusses a heat pump development plan for the county of Soer-Troendelag (Norway). The heat source potentials together with temperature conditions for lakes, rivers and seawater in the region are discussed and presented. The different types of heat pump system are considered, and an evaluation of such systems for several areas the region is done by means of the computer program PROSIM. 12 drawings, 4 tables.

14879 (STF—15A87023) Energy and power demand by district heating development. Ulseth, R. (SINTEF, Trondheim (Norway)). May 1987. 26p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751217/JAW.

The report presents a calculation method for estimating the optimal capacity of a district heating system in relation to the energy and power demand. The quantification of power and energy demands depends on aspects such as the utilization time, building categories and climate conditions. Examples are given. 6 drawings, 4 tables.

14880 (VTT-TUTK—466) Measurement of combustion aerosol size distributions with multistage inertial impactors. Kauppinen, E.; Larjava, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Feb 1987. 54p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751101/JAW.

The suspensions of particles and gases released from combustion processes are called combustion aerosols. In this study, the use of log-normal distribution functions to characterize the size distribution and methods for measuring the size of combustion aerosols are described. In the experimental part of the study, mass and heavy metal size distributions of municipal waste combustion aerosols were determined. To measure combustion aerosol size distributions, basically two methods can be used. Mass, elemental and compound size distributions can be determined by using in-situ size-classifying sampling methods followed with analysis of samples. Another method is the extraction, dilution and cooling of the sample and number size distribution measurement with aerosol size analysers in the fine particle size range 0.01-2 μm. Mass, Cd, Pb and Zn size distributions of municipal waste combustion aerosols were determined in the size range 0.1-5 μm. Size-classified samples were collected with an in-stack cascade impactor (University of Washington Mark 5) on glass fiber filter and greased foil substrates. Mass was analysed gravimetrically and metals y atomic absorption spectrophotometry. Differential mass and metal size distributions exhibit a clear mode in the size range 0.1-0.5 μm. Fine particle (D/sub p/<2 μm) heavy metal concentrations c/sub i/ (i=Cd, Pb and Zn) were found to be c/sub Cd/=0.30 +- 0.20 mg/m"3, c/sub Pb/=1.0 +- 0.4 mg/m"3, c/sub Zn/=7 +- 5 mg/m"3, in dry gas at T = 273 K and p = 101.3 kPa.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 14775, 14799

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

14881 (ORNL/M—318) Users facilities and technology to support automobile components manufacturing. Trauger, D.B. (comp.). (Oak Ridge National Lab., TN (USA)). Mar 1987. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005180/JAW.

The listings and brief essays which are included describe capabilities and programs primarily at the Oak Ridge National Laboratory which can support automobile components manufacturing essential needs. Technical reports, consulting, the use of facilities, and, in some cases, directly supported work can be undertaken. Licenses to some patented technologies may be available directly from Martin Marietta Energy Systems, Inc., on an exclusive or nonexclusive basis. ORNL is presently in consultation with and provides support to several companies and government agencies which are in the automobile transportation system. These include the General Motors Research Laboratory, the Ford Motor Company, the Cummins Engine Company, and the Department of Transportation. Access to these services is available through the Martin Marietta Energy Systems, Inc., Office of Technology Applications.

3301 Internal Combustion Engines

14882 (PB—88-122643/XAB) Survey of heavy-duty diesel-engine rebuilding, reconditioning, and remanufacturing practices. Final report. (Sierra Research, Inc., Sacramento, CA (USA)). Aug 1987. 152p. NTIS, PC A08/MF A01.

A survey was conducted to determine the emissions impact of rebuilt, reconditioned, and remanufactured heavy-duty diesel engines sold in California. Information was collected from fleet maintenance shops, independent rebuild shops, and diesel-injection repair specialists on the frequency of improper rebuilding practices observed in the field. Data were also collected from manufacturers and regulatory agencies on the emissions impact of improper rebuilding practices.

14883 (VTT-TIED—712) Exhaust gas emissions from diesel engine cars. Laurikko, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). May 1987. 90p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751100/JAW.

Exhaust emissions of a diesel engine differ from those of a petrol-fueled Otto-cycle engine in many respects. In the diesel engine, unburned hydrocarbons and other products of uncomplete oxidation are formed as a result of low local oxygen concentration due to uncomplete mixing of fuel and air. A high combustion pressure and temperature, and a high oxygen concentration, as a result of high excess air, produce an abundance of nitrogen oxides as by-products of the combustion. Carbon (soot) particles, which can be observed as smoke emission, are formed during the combustion through pyrolysis and condensation-dehydration reactions from the long hydrocarbon chains of the fuel. Polycyclic aromatic hydrocarbons (PAH) are bound with soot particles. The carbon monoxide yield of the diesel engine is typically low as combustion usually occurs in abundant excess air. The amount and composition of diesel exhaust emissions are primarily affected by the design of the engine. The formation of harmful products can be reduced by intensifying the combustion. Emissions can also be reduced with exhaust gas aftertreatment. However, the means of reducing the formation of nitrogen oxides usually result in an increase in fuel consumption or particle emissions. The use of electronic control systems together with turbocharging and intercooling will reduce harmful emissions in the next few years, although the lowering quality of diesel fuel as a consequence of production alterations can partly increase the emissions. The design of particle filters is being developed, and some catalytic after-treatment systems may also be introduced.

3302 External Combustion Engines

14884 (DOE/NASA/50112—72) Hot piston ring tests. Allen, D.J.; Tomazic, W.A. (Sverdrup, Inc., Middleburg Heights, OH (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. Contract AI01-85CE50112. 16p. (CONF-8710116—5; NASA-TM—100256). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004888/JAW.

From 25. automotive technology development contractor's coordination meeting; Dearborn, MI, USA (26 Oct 1987).

As part of the DOE/NASA Automotive Stirling Engine Project, tests were made at NASA Lewis Research Center to determine whether appendix gap losses could be reduced and Stirling engine performance increased by installing an additional piston ring

near the top of each piston dome. An MTI-designed upgraded Mod I Automotive Stirling Engine was used for these tests. Unlike the conventional rings at the bottom of the piston, these rings operated in a high temperature environment (700°C). Because of this, we called them "hot-rings." It was necessary that they be made of a high temperature alloy (Stellite 6B) and that a high temperature solid lubricant coating (NASA Lewis-developed PS-200) be applied to the cylinder walls. Engine tests were run at 5, 10, and 15 MPa operating pressure over a range of operating speeds. Tests were run both with the hot-rings in place and without them to pro-side a baseline for comparison. Although budget and schedule restrictions severely limited the testing, the minimum data to assess the potential of both the hot-rings and high temperature low friction coating was obtained. Results indicated a slight increase in power and efficiency with the hot-rings over the baseline configuration. This increase was over and above the friction loss introduced by the hot-rings. Seal leakage measurements showed a significant reduction in leakage with the hot-rings in place. In addition, cylinder wall temperature measurements indicated less cylinder heating in the appendix gap area - between the lower piston rings and the hot-ring. Approximately 22.4 hours of ring-on-coating operation were recorded. After the initial break-in period, wear on both the rings and the coating was low. The PS-200 coating seems to offer significant potential for long-term operation at high temperatures. Both the hot-ring and the PS-200 low friction coating show promise and should be pursued further.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 14717

14885 (DOE/NV/10112—T1) Electric vehicle demonstration project: Draft final closeout report. (Cypress, City of, CA (USA)). Dec 1987. Contract FC08-80NV10112. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004076/JAW.

On February 27, 1980, the city of Cypress was awarded a federal grant to participate in the Department of Energy's Electrical Vehicle Demonstration Program. The initial Cooperative Agreement (CA) between the city and the Department of Energy (DOE), was executed May 13, 1980, for a four (4) year period. The first year of the Agreement was dedicated to acquiring the vehicles, training the operators and designing the data collection system. Both parties entered into several annual CA modifications which extended the program through December 31, 1986. The city began receiving shipment of the vehicles in November 1980, with all vehicles recieved by April 1981. The electric vehicles were assigned to a wide variety of city service areas including: maintenance, police parking enforcement, engineering, planning, recreation and parks and central services.

14886 (LA—10948-MS) Fuel cell/battery hybrid vehicle assessment. Murray, H.S.; Huff, J.R. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 126p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88005087/JAW.

The concept of a hybrid vehicle has emerged as a result of the need to reduce petroleum consumption, to provide for pollution-free electric propulsion, and, at the same time, to maintain a full-performance capability comparable with conventional internal-combustion-engine-powered vehicles. The purpose of this study is to examine the possibility of using a fuel cell/battery hybrid propulsion system configured to take advantage of the best attributes of both power sources. An assessment of the state-of-development of fuel cells and batteries was performed. Based on this assessment, the phosphoric acid (PA) and proton exchange membrane (PEM) fuel cells were selected for use in this study. Methanol was the choice for the fuel cell fuel. Lead-acid and nickel-zinc batteries were designated as the battery types to be used; the latter served as representative of advanced battery technology. A survey was made of DOE-sponsored programs on motors, controllers, and transmissions to provide specifications for the electric vehicle power train. The power plant is configured so that the fuel cell provides the average duty cycle power requirement and the battery serves to meet the peak power demands. The Urban Driving Schedule (UDS) requirements were used to determine the relative fuel cell and battery powers. Factors used in defining these powers were short-duration peak power capability, peak power volume constraints, fuel cell transient capabilities, use of regenerative braking, and battery size limits imposed by impedance matching with the parallel fuel cell and the controller input voltage range.

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 14886

3306 Vehicle Design Factors

14887 Semiconductor bridge (SCB) igniter. Bickes, R.W. Jr.; Schwartz, A.C. (to Dept. of Energy, Washington, DC). US Patent 4,708,060. 24 Nov 1987. Filed date 19 Feb 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

An explosive device is described comprising: a non electrically conducting substrate; an electrical material mounted on the substrate and having a negative temperature coefficient of electrical resistivity at an elevated temperature. The material covers an area of the substrate and defines a pair of spaced pads connected by a bridge; a metallized layer covering each of the spaced pads; an electrical conductor connected to each of the metallized layers, whereby the electrical resistance between the electrical conductors is substantially determined by the electrical resistance of the bridge; and an explosive material covering the device, the area of the bridge in contact with the explosive material being sufficient to ignite the explosive material when the bridge forms a plasma due to electrical current passing therethrough.

3307 Emission Control

REFER ALSO TO CITATION(S) 14882, 14883, 16044

14888 (AD-A—185703/6/XAB) CRC (Coordinating Research Council) octane number requirement survey, 1986. (Coordinating Research Council, Inc., Atlanta, GA (USA)). Aug 1987. 167p. (CRC—553). NTIS, PC A08/MF A01.

In the fortieth annual statistical survey of current model vehicles conducted by the Coordinating Research Council, Inc., test data were obtained on 377 1986 model vehicles, including 314 US vehicles and 63 imported vehicles. Sixteen laboratories participated in this survey. Maximum octane number requirements were determined by testing at maximum-throttle conditions, as well as a part-throttle. Requirements are expressed as the (R+M)/2 octane number, Research octane number, and motor octane number of the reference fuel producing knock which was recurrent and repeatable at the lowest audible level. The primary analyses used in this report are based upon (R+M)/2 octane number requirements, rather than upon Research octane number requirements as in the survey reports prior to 1985. Estimated octane-number requirements for the US vehicles are weighted in proportion to the 1986 vehicle model production figures and, for the imported models, in proportion to import sales volume in the United States.

14889 (NP—8751699) Cars and the environment. Daimler-Benz on commercial vehicles. (Daimler-Benz A.G., Stuttgart (Germany, F.R.)). May 1985. 43p. (In German). NTIS (US Sales Only), PC A03. Order Number DE88751699/JAW.

The car industry started at an early stage to reduce pollutant emissions and initiated research on the dispersion and effects of airborne pollutants. The problem is reviewed from the view of commercial vehicles, including European exhaust legislation for passenger cars and commercial vehicles (gaseous emissions, diesel smoke, particle emissions, exhaust legislation) and the share of commercial vehicles in the total emissions. The main goals of development in commercial vehicles are named (low fuel consumption, low emission, low noise), and suggestions are made for further pollutant reduction (NO emissions, exhaust recirculation, other combustion technologies, alternative fuels). A status report is given on soot filter technology, diesel catalysts, diesel fuel and exhaust emissions,

national exhaust limits, and European noise regulations. Asbestos-free friction linings are mentioned. (HWJ).

14890 (PB—88-116538/XAB) Modeling and measurement of vehicle emissions from roadways. Volume 1. Final report, September 1979-August 1987. Bullin, J.A.; Hlavinka, M.W.; Korpics, J.J.; Schroeder, J.H.; Moe, R.D. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Jul 1987. 362p. (TTI—2-8-80-283-3F-VOL-1). NTIS, PC A16/MF A01.

See also Volume 2, PB—88-116546.

Both experimental and model development in air-pollution research near roadways was conducted. The original TXLINE model was modified so that it was suitable for use in modeling finite-line sources. The modification enables the model to be used in modeling pollutant dispersion on curved roads and other types of scenarios for which an infinite line-source model would not be applicable. The modification also allows the model to be used in predicting pollutant concentrations upwind of a roadway. The Texas intersection model, TEXIN was reviewed. Finally, the collection of a large experimental data base was performed under the project. Data on meteorology, traffic, and pollutant concentrations were obtained in Houston, Texas. These data were used in the mass-balance technique to estimate carbon monoxide emission factors which were then compared to the simulated factors obtained by the EPA model MOBILE3. The primary purpose of the data base is the improvement and development of future roadway air-quality models.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 14021, 14024

14891 (DOE/MC/10637—2414-Vol.3, pp 1-48, Paper 4) Heat engines utilization of low-rank coal: First-year technical report for the period April 1, 1986-March 31, 1987 including the quarterly technical progress report for the period January through March 1987. Mann, M.D.; Swanson, M.L.; Collings, M.E.; Potas, T.A.; Ellman, R.E.; Hauserman, W.B. Apr 1987. NTIS, PC A10/MF A01. Order Number DE87006533/JAW.

In Low-rank coal research: Volume 3, Combustion research: Final report.

Low-rank coals have several properties that make them ideal as candidates for fuels in heat engine applications. These properties include a high reactivity and a potential to not agglomerate as much as bituminous slurries. Potential problems that require investigation include the higher ash and lower heat content of the low-rank coals. Evidence indicates that chemical and/or physical cleaning methods can be used to lessen the impact of the high ash and alkali content; however the level to which these cleaning methods can solve all these problems has yet to be determined. The observations and findings from the work underway at six heat engine test sites allowed UNDERC personnel to become acquainted with the current research underway at these institutions and to incorporate several design changes to the test simulators being designed at UNDERC. An extensive literature review on various hot gas clean-up techniques for controlling particulate and gaseous emissions at high temperatures and pressures and a review on corrosion/erosion in advanced combustion systems have also been performed. Major accomplishments also include the design fabrication, procurement, and construction of the constant volume combustion bomb and adiabatic calorimeter for testing and comparing the reactivity of various coal derived diesel fuels. Similarly, a diesel engine simulator consisting of single stroke for the study of a variety of engine operating conditions as well as a variety of fuels was designed and is in process of installation and assembly. 32 refs., 18 figs., 14 tabs.

14892 (PB—88-117171/XAB) Technical feasibility, socio-economic impact, and environmental benefits of alternate-energy vehicles as related to the state of Arizona. Volume 1. Technical summary. Final report. Saczalski, K.J.; Mullens, L.J.; Schnorr, J.; Morgan, J.F. (Northern Arizona Univ., Flagstaff (USA)). Aug 1986. 431p. NTIS, PC A19/MF A01.

The study analyzes the potential market penetration in Arizona of various types of alternate-energy vehicles. The market penetration is analyzed in terms of changes in the price of fuel, tax incentives, costs of conversion and consumer attitudes. Short-term market penetration, in the absence of legal intervention, is expected to amount to a very small fraction of the total operating fleet of motor vehicles.

35 ARMS CONTROL

3501 Policy, Negotiations, And Legislation

REFER ALSO TO CITATION(S) 15947, 15951

14893 (ACDA—8900285) Verification: What is to be done? ACDA occasional papers No. 3. Eimer, M. (Arms Control and Disarmament Agency, Washington, DC (USA)). 9 Apr 1987. 9p. US Arms Control & Disarmament Agency, New Exec. Off. Bldg., Washington, DC 20503. Order Number TI88900285/JAW.

In answer to an article by Soviet Major General Yuri V. Lebedyev entitled "Why Should We Formulate Verification Procedures If There Is No Agreement On The Subject Matter?" which appeared in "Die Welt," the author sets forth the US position on the central role verification plays in the arms control process. Verification problems in nuclear weapons testing, space weapons, nuclear weapons reductions, chemical/biological weapons, and mutual reduction of armed forces and armaments in Europe are discussed. (ACR)

14894 Technical feasibility of the SDI. May, M. (Lawrence Livermore National Lab., Livermore, CA). pp 125-140 of Strategic defenses and Soviet-American relations. Wells, S.F.; Litwak, R.S. Cambridge, MA; Ballinger Publishing Co. (1987).

The authors maintain that there are some interesting technologies in the SDI, but as yet no great leverage on the strategic balance. There may be some in the future or there may never be. The leverage would come in the form of effective damage limitation, rather than as a complete shield. They see no technological way to escape an enormous amount of damage in the event of nuclear war. It could be decisively less, but it would still be substantial. They mention three implications of what they have reviewed. First, if we ask about stability - either crisis stability or arms race stability - in an era in which defenses are deployed and are partially effective, the key to the answer is whether offensive forces continue to be survivable or not. If the offensive forces are not very survivable, then partially effective defenses will be more effective against a somewhat decimated second-strike force than they would against a first-strike force. In such a case, partial defenses would act in the wrong direction as far as crisis stability is concerned.

36 MATERIALS

REFER ALSO TO CITATION(S) 16532, 17186, 17189, 17338

14895 (CONF-8708200—1) Void formation in solidification. Alexiades, V. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Mathematics). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003895/JAW.

From EQUADIFF '87; Xanthi, Greece (1 Aug 1987).

Some interesting physical and mathematical problems, arising in solidification processes when density changes are taken into account, are briefly described. 8 refs.

14896 (DOE/ID/12380—18) Investigation of materials for inert electrodes in aluminum electrodeposition cells. Haggerty, J.S.; Sadoway, D.R. (Massachusetts Inst. of Tech., Cambridge (USA)). 14 Sep 1987. Contract FG07-83ID12380. 250p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88003380/JAW.

Work was divided into major efforts. The first was the growth and characterization of specimens; the second was Hall cell performance testing. Cathode and anode materials were the subject of investigation. Preparation of specimens included growth of single

crystals and synthesis of ultra high purity powders. Special attention was paid to ferrites as they were considered to be the most promising anode materials. Ferrite anode corrosion rates were studied and the electrical conductivities of a set of copper-manganese ferrites were measured. Float Zone, Pendant Drop Cryolite Experiments were undertaken because unsatisfactory choices of candidate materials were being made on the basis of a flawed set of selection criteria applied to an incomplete and sometimes inaccurate data base. This experiment was then constructed to determine whether the apparatus used for float zone crystal growth could be adapted to make a variety of important based melts and their interactions with candidate inert anode materials. The third major topic was Non Consumable Anode (Data Base, Candidate Compositions), driven by our perception that the basis for prior selection of candidate materials was inadequate. Results are presented. 162 refs., 39 figs., 18 tabs.

14897 **(N—88-13015) Nuclear techniques in studies of condensed matter.** Singh, J.J. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Aug 1987. 22p. (NASA-RP—1195; L—16361; NAS—1.61:1195). NTIS, PC A03/MF A01.

Nuclear techniques have played an important role in the studies of materials over the past several decades. For example, x-ray diffraction, neutron diffraction, neutron activation, and particle- or photon-induced x-ray emission techniques have been used extensively for the elucidation of structural and compositional details of materials. Several new techniques have been developed recently. Four such techniques are briefly reviewed which have great potential in the study and development of new materials. Of these four, Mossbauer spectroscopy, muon spin rotation, and positron annihilation spectroscopy techniques exploit their great sensitivity to the local atomic environments in the test materials. Interest in synchrotron radiation, on the other hand, stems from its special properties, such as high intensity, high degree of polarization, and high monochromaticity. It is hoped that this brief review will stimulate interest in the exploitation of these newer techniques for the development of improved materials.

14898 **(SAND—86-8843) A numerical model of the flow and heat transfer in a rotating disk chemical vapor deposition reactor.** Evans, G.H.; Greif, R. (Sandia National Labs., Livermore, CA (USA); California Univ., Berkeley (USA). Dept. of Mechanical Engineering). Jul 1986. Contract AC04-76DR00789. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005179/JAW.

Steady, laminar, axisymmetric and circumferentially uniform flow and heat transfer, including the effects of variable properties and buoyancy, have been modeled within a rotating disk chemical vapor deposition (CVD) reactor. The reactor is oriented vertically, with the hot, isothermal, spinning disk facing upward. The Navier-Stokes and energy equations have been solved for the carrier gas helium, at atmospheric pressure. The solutions have been obtained over a range of parameters which is of importance in CVD applications. The primary parameters are the ratio of the disk temperature to the free stream temperature T/sub ω//T/sub ∞/, the disk Reynolds number Re = r/sub d/²ω/ν/sub ∞/, a mixed convection parameter Gr/Re/sup 3/2/ = g(1 - rho/sub ω//rho/sub ∞/)/(ω√ων/sub ∞/), the dimensionless inlet velocity u/sub ∞//√ων/sub ∞/, and two geometric parameters r_o/r/sub d/ and L/r/sub d/. Results are obtained for the velocity and the temperature fields and for the heat flux at the surface of the rotating disk. Comparisons are made with the one-dimensional, variable properties (excluding buoyant effects), infinite rotating disk solutions of Pollard and Newman. Results are presented in terms of a local Nusselt number. The potential uniformity of CVD in this geometry can be inferred from the variation of the Nusselt number over the surface of the rotating disk. The effects of buoyancy and the finite size of the rotating disk within the cylindrical reactor evident.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 13932, 14025, 14032, 14306, 14450, 14485, 14519, 14521, 14521, 14535, 14536, 14537, 14541, 14560, 14608, 14609, 14612, 14613, 14675, 14849, 15353, 15359, 15438, 15489, 15533, 15574, 15574, 15695, 15898, 17178, 17357

14899 **(AD-A—185574/1/XAB) Tension testing of very thin electrodeposits.** Kim, I.; Weil, R. (Stevens Inst. of Tech., Hoboken, NJ (USA)). 1987. 9p. NTIS, PC A02/MF A01.

Pub. in Testing of Metallic and Inorganic Coatings, 11-18(1987).

A tension-testing machine is described for determining the mechanical properties of thin-foil specimens with dimensions scaled so that the width-to-thickness ratio is sufficiently small so that the strain across the specimen is uniform. The loads are applied by means of a computer-controlled stepping motor having a linear motion of 10 nm/step. The gauge-length change is measured optically. There is the capability to vary the strain rate between .0004/s and 8/s and for low-frequency fatigue testing. The mechanical properties of electroplated nickel, nickel-molybdenum, and nickel phosphorus alloys were determined.

14900 **(AD-A—185713/5/XAB) Effect of ion implantation on the corrosion behavior of a high-density sintered tungsten alloy.** Chang, F.C.; Levy, M.; Lin, S.S. (Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab.). Aug 1987. 17p. (MTL-TR—87-38). NTIS, PC A03/MF A01.

The effect of chromium, nickel, tantalum, and titanium ion implantation on the electrochemical corrosion behavior of a high-density sintered tungsten alloy was investigated in Cl^- -free and chlorine-ion containing aqueous solution buffered to pH values of 4, 9, and 12. A three sweep potentiodynamic polarization technique was used to compare the polarization behavior of unimplanted and implanted surfaces. The surfaces of the ion-implanted tungsten alloy were characterized by Auger electron spectroscopic (AES) analysis.

14901 **(AEEW-R—2118) Elemental release rates from Inconel 600 and 304L stainless steel.** Butter, K.R. (UKAEA Atomic Energy Establishment, Winfrith). Aug 1986. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750978/JAW.

Release rates for cobalt, iron and nickel under PWR conditions have been calculated and compared with previous studies. The release of these elements from Inconel-600 is approximately stoichiometric with respect to each element whereas nickel was found to be preferentially released with respect to cobalt and iron from 304L stainless steel. (U.K.).

14902 **(AERE-M—3592) Materials selection for Winfrith waste containers.** Marsh, G.P. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Nov 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750966/JAW.

The report makes a preliminary evaluation of the corrosion behaviour of the austenitic stainless steel and carbon steel candidate materials for Winfrith nuclear waste containers. It is concluded that both groups of materials could be used provided certain corrosion protection measures are incorporated in the container design. It is also recommended that a surveillance programme should be planned to check on the condition of actual waste drums.

14903 **(AERE-R—11717) Development of fusion first-wall radiation damage facilities. (EURATOM/UKAEA fusion technology Task MAT-9, April 1983 -March 1985).** McElroy, R.J.; Atkins, T. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Nov 1986. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750948/JAW.

The report describes work performed on the development of fusion-reactor first-wall simulation facilities on the Variable Energy Cyclotron, at Harwell, United Kingdom. Two irradiation facilities

have been constructed: i) a device for helium and hydrogen filling up to 1000 ppm for post-irradiation mechanical properties studies, and ii) a helium implantation and damage facility for simultaneous injection of helium and radiation damage into a specimen under stress. These facilities are now fully commissioned and are available for investigations of first-wall radiation damage and for intercorrelation of fission- and fusion -reactor materials behaviour. (U.K.).

14904 **(AERE-R—12383) Influence of injected interstitials on void swelling in 316 steel under ion bombardment.** Murphy, S.M. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Oct 1986. 36p. H.M. Stationery Office, London, price Pound 5.00.

The report considers the influence of injected interstitial atoms on void swelling in 316 steel under ion bombardment. Also the variation in the displacement damage rate with position on the growth of voids is investigated. The reduction in the density of vacancy loops produced by the extra interstitials is found to lead to an increase in the void swelling at low temperatures. However, in most cases a high dislocation density is produced in the steel by ion irradiation, and this reduces the impact both of the extra interstitials and of the diffusion of point defects away from the peak damage region. Rocking the ion beam is found to produce void growth, but again the high dislocation density in irradiated 316 steel reduces the magnitude of this effect. (U.K.).

14905 **(AERE-R—12388) Effects of sulphate reducing bacteria on the corrosion of mild steel embedded in a bentonite-granitic groundwater paste.** Philp, J.C.; Taylor, K.J. (UKAEA Harwell Lab. Materials Development Div.; Department of the Environment, London (UK)). Aug 1987. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751823/JAW.

Preliminary experiments were set up to investigate how the corrosion of forged 0.2% carbon steel is affected by the presence of sulphate reducing bacteria (SRB). The tests used cultures of a thermophilic bacterium Desulphotomaculum nigrificans mixed with bentonite and synthetic groundwater, to simulate a bacteria contaminated backfill, and placed in contact with carbon steel disc specimens held in perspex cells at 50/sup 0/C under anaerobic conditions. The rate of corrosion with exposure was monitored by electrochemical techniques, together with changes in near field redox potential, during the course of the tests. After 340 days exposure the test cells were dismantled to measure the nature and extent of any corrosion that had occurred and to assess the residual SRB content of the bentonite. Recovery of relatively large numbers of bacteria after almost a year's incubation at 50/sup 0/C in this moderately alkaline (pH 9.5) medium has confirmed the pH tolerance of the strain. There was evidence of the initiation of enhanced corrosion occurring in at least two of the five cells that contained SRB, at about three times the rate of the control. This was probably associated with the presence of SRB despite the nutritionally poor environment which existed in the bentonite gel.

14906 **(AERE-R—12510) Corrosion of carbon steel nuclear waste containers in marine sediment.** Marsh, G.P.; Taylor, K.J.; Harker, A.H. (UKAEA Harwell Lab. Materials Development Div.; Department of the Environment, London (UK)). Aug 1987. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751825/JAW.

The report describes a study of the corrosion of carbon steel nuclear waste containers in deep ocean sediments, which had the objective of estimating the metal allowance needed to ensure that the containers were not breached by corrosion for 1000 years. It was concluded that under such disposal conditions carbon steel would not be subject to localised corrosion or hydrogen embrittlement, and therefore the study concentrated on evaluating the rate of general attack. This was carried out by developing a mechanistically based mathematical model which was formulated on the conservative assumption that the corrosion would be under activation control, and would not be impeded by the formation of corrosion product layers. This model predicted that an allowance of 33 mm would be required for a 1000 year life.

14907 **(BNL—40484) Magnetic rare earth superlattices.** Majkrzak, C.F.; Gibbs, D.; Boeni, P.; Goldman, A.I.; Kwo, J.; Hong, M.; Hsieh, T.C.; Fleming, R.M.; McWhan, D.B.; Yafet, Y. (Brookhaven National Lab., Upton, NY (USA); AT and T Bell Labs., Murray Hill, NJ (USA); Oak Ridge National Lab., TN (USA); Risoe National Lab., Roskilde (Denmark); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Johns Hopkins Univ., Baltimore, MD (USA)). 1987. Contract AC02-76CH00016;AC05-84OR21400. 26p. (CONF-871126—9). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003483/JAW.

From 32. conference on magnetism and magnetic materials; Chicago, IL, USA (9 Nov 1987).

The magnetic structures of several single-crystal, magnetic rare earth superlattice systems grown by molecular beam epitaxy are reviewed. In particular, the results of recent neutron diffraction investigations of long-range magnetic order in Gd/Y, Dy/Y, Gd/Dy and Ho/Y periodic superlattices are presented. In the Gd/Y system, an antiphase domain structure develops for certain Y layer spacings, whereas modified helical moment configurations are found to occur in the other systems, some of which are commensurate with the chemical superlattice wavelength. References are made to theoretical interaction mechanisms recently proposed to account for the magnetic states of these novel materials. 33 refs., 6 figs., 1 tab.

14908 **(BNL—40543) The effect of magnetic impurities and barriers on the magnetization and critical current of fine filament NbTi composites.** Ghosh, A.K.; Sampson, W.B.; Gregory, E.; Kreilick, S.; Wong, J. (Brookhaven National Lab., Upton, NY (USA); Supercon, Inc., Shrewsbury, MA (USA)). 1987. Contract AC02-76CH00016. 4p. (CONF-870901—23). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004443/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

It has been shown that the highest critical currents in fine filament NbTi conductors are obtained when the filaments are closely spaced. However, the filaments in a composite with a high purity copper matrix tend to be coupled via the "proximity effect" as the filament spacing is reduced leading to large magnetization at low fields. To reduce the "proximity" coupling, trial billets of NbTi have been fabricated with Cu-30% Ni matrix, Cu-0.5% Mn matrix and one with a Ni barrier around the filaments. Wires drawn from these billets have shown that this interfilament coupling can be suppressed for very small filament separations. A full sized commercial billet with Cu-0.5% Mn matrix demonstrates that high J/sub c/ conductors with filament size ~1 to 5 μm can be fabricated which show no interfilament coupling at low fields.

14909 **(CEA-CONF—8998) Fragile and ductile rupture of 16MND5 steel, radiation effects.** Al Mundheri, M.; Soulat, P.; Pineau, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Jun 1986. 14p. (In French). (CONF-8606228—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751325/JAW.

From International seminar on local approach of rupture; Moret-sur-Loing, France (3 Jun 1986).

Strength tests have been made on 16MND5 steel before and after irradiation at 290/sup 0/C. Tests have been made in the cleavage rupture domain. Variation of strength with temperature and irradiation have been shown.

14910 **(CEA-CONF—9000) Study of point defects in non crystalline alloys by high temperature mass transport experiments.** Limoge, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Sep 1986. 7p. (CONF-860953—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751327/JAW.

From International conference on vacancies and interstitials in metals and alloys; Berlin, F.R. Germany (14 Sep 1986).

We present in this communication the results of new experiments designed to study the mass transport mechanism in non-crystalline metallic alloys. They are based on the isothermal measure-

ment of the crystallization kinetics, either without constraint or under electron irradiation or hydrostatic pressure. These experiments show that in the alloys studied, (FeNi)/sub 8/(Pb)/sub 2/ and Ni/sub 6/Nb/sub 4/), irradiation enhances the diffusion on the one hand, and on the other that there exist an activation volume for diffusion, of the order of one atomic volume. We discuss then the atomic model of diffusion needed to explain our results.

14911 **(CEA-CONF—9001) New diffusion mechanism for high temperature diffusion in solids.** Doan, N.V.; Adda, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Sep 1986. 7p. (CONF-860953—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751328/JAW.

From International conference on vacancies and interstitials in metals and alloys; Berlin, F.R. Germany (14 Sep 1986).

A new atomic transport mechanism in solids at high temperatures has been discovered by Molecular Dynamics computer simulation. It can be described as a ring sequence of atomic replacements induced by unstable Frenkel pairs. This transport process takes place without stable defects, the atomic migration occurring indeed by simultaneous creation and migration of unstable defects. Starting from the analysis of this mechanism in different solids at high temperature (CaF/sub 2/, Na, Ar) and in irradiated copper by subthreshold collisions, we discuss the role of this mechanism on various diffusion controlled phenomena and also on the atomic processes of defect creation.

14912 **(CEA-CONF—9002) Radiation amorphization of metallic alloys: a molecular dynamics simulation approach.** Limoge, Y.; Rahman, A.; Yip, S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Sep 1986. 7p. (CONF-860953—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751329/JAW.

From International conference on vacancies and interstitials in metals and alloys; Berlin, F.R. Germany (14 Sep 1986).

The molecular dynamic results reported here show the possibility of amorphising a pure Lennard-Jones crystal by the introduction of point defects; these can be either Frenkel pairs or isolated interstitials and have to be introduced at a sufficiently high rate and at a sufficiently high number density. The detailed examination of the atomistic mechanism has evidenced that an athermal migration mechanism is responsible for the interstitials elimination by clustering. This mechanism is nearly as efficient as the Frenkel pairs recombination.

14913 **(CEA-CONF—9003) Effect of Si, Ge, Sb solute atoms on the void nucleation in electron irradiated nickel.** Nguy, T.; Corbel, C.; Moser, P.; Barbu, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Sep 1986. 7p. (CONF-860953—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751330/JAW.

From International conference on vacancies and interstitials in metals and alloys; Berlin, F.R. Germany (14 Sep 1986).

H.V.E.M. experiments in Ni and dilute Ni alloys show that the void nucleation rate is increased in NiSb, unchanged in NiGe, decreased in NiSi. The dislocation density is found higher in NiSi and NiSb than in Ni, and the same in NiGe as in Ni. Positron lifetime experiments show that the vacancy mobility is lower in NiSb than in Ni and remains unchanged in NiSi. Our experimental results can be understood in a simple model of void nucleation including the solute effects on the point defect mobilities and the dislocation density.

14914 **(CEA-CONF—9046) Continuous fatigue of non irradiated zircaloy 4 tubes.** Lemoine, P.; Darchis, L.; Pelchat, J.; Mardon, J.P.; Grosgeorges, X. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). May 1987. 15p. (In French). (CONF-8705237—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751542/JAW.

From IAEI technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

Future operation of PWR requires already to consider consequences of load following and remote adjustment on nuclear fuel behaviour. An important qualification program is set up including fatigue and fatigue-creep of fuel cans in zircaloy 4. A device for testing low cycle fatigue at 350/sup 0/C, by repetitive action of an internal pressure on tube sections is developed. Fatigue curves and resistance at 10/sup 6/ cycles are determined for a frequency of 0.5 Hz. Results obtained, corrected for biaxiality, agree with those published for monaxial resistance are correlated.

14915 **(CEA-CONF—9050) Hydrogen gas embrittlement (HGE) at very low speed and fractography of high-strength, mainly austenitic, stainless steels.** Azou, P.F.; Talbot-Besnard, S.; Fidelle, J.P. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). May 1987. 13p. (In French and English). (CONF-8705240—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751712/JAW.

From 26. colloquium on special steels; Toulouse, France (20 May 1987).

Different austenitic stainless steels: 316L, 316ELC, 302, 302L, XN26TW, XN26TWS, JBK75, UM95, 21-6-9, 22-13-5 and 21-14-6 are tested by the disk pressure test and ruptured disk are examined metallographycally. Influence of hardening by cold work, by γ, phase precipitation and by N in solid solution is examined. Results are compared and discussed.

14916 **(CEA-CONF—9076) Mechanical properties of weldings by electron beams on alloy 8090 (CP 271).** Le Poac, P.; Nomine, A.M.; Miannay, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Jun 1987. 9p. (In French). (CONF-8706222—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751351/JAW.

From 4. international aluminum lithium conference; Paris, France (10 Jun 1987).

Weldings by electron beams got on rings in alloy 8090 in the T4 and T6 state are mechanically tested in traction in the original state of welding or after a thermal processing of 12 hours at 210/sup 0/C.

14917 **(CEA-CONF—9092) Zircaloy superficial quenching by laser.** Richard, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Jun 1987. 23p. (In French). (CONF-8706250—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751556/JAW.

From INSTN meeting on laser applications in metallurgy; Saclay, France (23 Jun 1987).

In zircaloy laser quenching, most of the transformation is a martensitic one. The chemical composition has been analysed with different methods. No concentration gradient has been found in zone depth. Radiocristallographic study allowed to characterize the parameter evolution of the hexagonal mesh and to show up the tensile surface stresses. Microhardness measurements allowed to characterize a recovered zone, underlying the quenched structure. The continuous sweeping of the surface by laser beam creates, focusingly a fast succession of thermal cycles by processed zone overthrusted.

14918 **(CEA-CONF—9093) Influence of laser treatment of beta phase on texture, mechanical properties and water corrosion of zircaloy 4.** Darchis, L.; Brun, G.; Baron, J.L.; Mardon, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Jun 1987. 22p. (In French). (CONF-8706250—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751557/JAW.

From INSTN meeting on laser applications in metallurgy; Saclay, France (23 Jun 1987).

Two heat treatments by laser of zircaloy 4 cladding tubes are compared: one is superficial (1/10th of the thickness) and the other full thickness. In the full thickness treatment a global attenuation of preferential orientations is induced without marked gradient with the same texture found in a classical heat treatment. A peculiar texture is observed when beta transformation affects only 1/10. Mechanical properties measured by elongation and burst tests at

20 and 400/sup 0/C are decreased by 40 to 60% for full thickness treatment and only 1 to 5% for superficial treatment. Water corrosion resistance at 360/sup 0/C in conditions found for PWR is slightly increased by treatment on full thickness. No decrease of behavior is observed after 6 months on the martensitic structure obtained by superficial treatment.

14919 **(CEA-CONF—9137) High cycle fatigue of austenitic stainless steels under random loading.** Gauthier, J.P.; Petrequin, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Aug 1987. 28p. (CONF-8708197—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751564/JAW.

From 6. international seminar on inelastic analysis and life prediction in high temperature environment; Paris, France (24 Aug 1987).

To investigate reactor components, load control random fatigue tests were performed at 300/sup 0/C and 550/sup 0/C, on specimens from austenitic stainless steels plates in the transverse orientation. Random solicitations are produced on closed loop servohydraulic machines by a mini computer which generates random load sequence by the use of reduced Markovian matrix. The method has the advantage of taking into account the mean load for each cycle. The solicitations generated are those of a stationary gaussian process. Fatigue tests have been mainly performed in the endurance region of fatigue curve, with scattering determination using stair case method. Experimental results have been analysed aiming at determining design curves for components calculations, depending on irregularity factor and temperature. Analysis in term of mean square root fatigue limit calculation, shows that random loading gives more damage than constant amplitude loading. Damage calculations following Miner rule have been made using the probability density function for the case where the irregularity factor is nearest to 100 %. The Miner rule is too conservative for our results. A method using design curves including random loading effects with irregularity factor as an indexing parameter is proposed.

14920 **(CEA-R—5404) Structural transformations in steels containing 12% chromium and 5 or 7% nickel. Influence of the reversed austenite on the mechanical properties.** Barreto-Phan Hoang, M.L. (Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Sep 1987. 180p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751729/JAW.

The production of austenite by the reverse martensitic transformation has been studied. The alloys concerned by this study are two 12% chromium low carbon steels containing respectively 5 and 7% nickel. Thermal treatments have been done in the intercritical temperature range. The kinetic of the $\alpha' \rightarrow \gamma$ transformation, the volumic fraction of reversed austenite and its stability after a subsequent cooling have been investigated as a function of the intercritical temperature. The purpose of such treatments is to develop an optimal mixture of tempered martensite and reversed austenite structure, which should improve the studied alloys mechanical properties and especially their high temperature properties for use in fast breeders. Creep properties are better than for classical martensitic steels (containing typically 0.1 to 0.2 weight carbon), and comparable to those of 316 type austenitic steels. This improvement of the mechanical properties seems to be tightly related to the high dislocations density observed in the reversed austenite which - besides - is dispersed as thin islands in the matrix.

14921 **(CEGB-TPRD/B—0787/R86) Positron annihilation examination of irradiated pressure vessel steels.** Buswell, J.T.; Highton, J.P. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Apr 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750823/JAW.

Three pressure vessel steels of type A508 class 3/A533B class 1, containing varying copper and phosphorus contents, have been examined by a Positron Annihilation technique before and after irradiation to doses of (approximately) 1×10^{23} n m^{-2} (E > 1 MeV) at 250° and 290°C. It has been demonstrated that the Doppler broadening of the 511 KeV annihilation γ peak can be qualitatively related to the radiation induced changes in hardness and, hence, embrittlement of the steels. The sensitivity of the change in broadening parameter (ΔS) as a function of change in hardness (ΔHsub(V)) is dependent on material composition. The addition of copper to a low copper-content control material reduced the sensitivity ($\Delta S/\Delta$Hsub(V)). The current interpretation is that the technique is strongly sensitive to the radiation damage (e.g. vacancy/microvoid) contribution to embrittlement but may be only weakly sensitive to that due to the radiation enhanced precipitation of copper in copper-containing steels. The work indicates that the Doppler broadening technique shows promise as a method for the surveillance of irradiated materials, provided appropriate data are available to calibrate the composition dependence.

14922 **(CONF-8312154—) Metallothermic processes in metal and alloy extraction: Proceedings.** Bose, D.K.; Krishnamurthy, N.; Mehra, O.K. (eds.). (Department of Atomic Energy, Kota (India)). 1983. 431p. NTIS (US Sales Only), PC A19. Order Number DE88900329/JAW.

From Symposium on metallothermic processes in metal and alloy extraction; Nagpur, India (28 Dec 1983).

Thirty-four papers are presented under the following section headings: metallothermy of common metals, metallothermic reduction of reactive and refractory metals, rare earth and nuclear metals by metallothermy, specialty ferroalloys by metallothermy, and post-reduction purification. (DLC)

14923 **(CONF-8705226—2) Electronic structure of random alloys and the theory of ordering processes.** Stocks, G.M.; Nicholson, D.M.; Pinski, F.J.; Johnson, D.D.; Gonis, A. (Oak Ridge National Lab., TN (USA); Naval Research Lab., Washington, DC (USA); Lawrence Livermore National Lab., CA (USA)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004476/JAW.

From U.S.-Japan seminar on electronic structure and lattice defects in alloys; Honolulu, HI, USA (4 May 1987).

Some of the approaches toward obtaining an understanding of alloy phase stability within the context of ab initio density functional theory are discussed. Recent results of calculations, using the concentration functional theory of Gyorffy and Stocks, of the spinodal for Pd/sub c/Rh/sub 1-c/ alloys are presented. Short-range order diffuse scattering patterns in Al/sub c/Ag/sub 1-c/ show that the intersite interactions change from clustering to ordering with increasing silver content. Implications of these results for the phase diagram of Al/sub c/Ag/sub 1-c/ alloys and for Guinier-Preston zone formation in aluminum-rich alloys are briefly discussed. In conclusion, some conjectures about what the future might hold regarding first-principles theories of phase stability are made. 22 refs., 4 figs.

14924 (CONF-8706187—, pp 77-84) **Laser diagnostics of PACVD processes for depositing hard face coatings.** Roman, W.C.; Stufflebeam, J.H.; Eckbreth, A.C.; Otter, F.A. (United Technologies Research Center, East Hartford, CT). Jun 1987. NTIS, PC A12/MF A01. Order Number DE88001479/JAW.

From 5. Symposium on energy engineering sciences; Argonne, IL, USA (17 Jun 1987).

rf plasma chemistry experiments (nonequilibrium) using a longitudinal PACVD flow reactor are being conducted to improve the understanding of the mechanisms which govern the reactive plasma atomistic or molecular deposition of hard face coatings for erosion resistant applications. TiB_2 coatings were formed on Ti-6Al-4V substrates using $TiCl_4$ and B_2H_6 reactants. The reflective metallic coatings (~ 1 μm thick) were smooth and the deposition rate was higher than generally reported levels. Analyses revealed the importance of substrate pretreatment/cleanliness and reactor contamination. Exploratory diagnostics include spectral emission surveys and narrowband, colinear, coherent anti-Stokes Raman spectroscopy (CARS) measurements. Since hardness and adhesion are critical parameters for characterizing tough, durable coatings, a

state-of-the-art ultramicrohardness tester and custom built adhesion test apparatus are being implemented.

14925 **(CONF-8709172—3) Automatic microtexture determination with synchrotron radiation.** Gottstein, G. (Michigan State Univ., East Lansing (USA). Dept. of Metallurgy, Mechanics and Material Science). 1987. Contract FG02-85ER45205. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004709/JAW.

From 8. international conference on textures of materials; Santa Fe, NM, USA (21 Sep 1987).

It is demonstrated that synchrotron radiation can be utilized to obtaina Laue back reflection pattern of microscopic areas with very short exposure time. A method is presented to fully automatically evaluate Laue patterns. The experimental setup and procedure is outlined to automatically determine the orientations of a large number of continguous grains, and consequently to enable orientation mapping and MODF generation. First experimental results are presented. 13 refs., 5 figs.

14926 **(DOE/ER/45129—3) Atomistic studies of the structure and properties of grain boundaries with substitutional impurities: Final report.** Vitek, V. (Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science and Engineering). Nov 1987. Contract FG02-84ER45129. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004161/JAW.

A number of atomistic computer simulation studies were carried out with the aim to understand the most important features of the grain boundary structures in pure metals, disordered alloys in which segregation takes place and also in some ordered alloys. All the grain boundary studies carried out in this project utilized empirically constructed pair-potentials to describe interatomic forces. We have, therefore, concentrated on those structural properties which are general, common to boundaries in various metals and alloys.

14927 **(DOE/ER/45205—3) Dynamic recrystallization during high temperature low cycle fatigue of nickel: Progress report, June 1, 1985-May 31, 1988.** Gottstein, G. (Michigan State Univ., East Lansing (USA)). Nov 1987. Contract FG02-85ER45205. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003224/JAW.

The mechanical behavior and the microstructural development associated with high-temperature low-cycle fatigue of nickel and static recrystallization of Ni_3Al were investigated. The occurrence of dynamic recrystallization during high-temperature low-cycle fatigue was substantiated. However, for the investigated range of strain amplitudes ($\Delta\epsilon \leqq 1.5\%$) dynamic recrystallization occurs only in polycrystals, but not in single crystals. Aluminum polycrystals were found not to undergo dynamic recrystallization during low cycle fatigue, in line with its behavior in monotonic deformation. Dynamic recrystallization during high temperature low cycle fatigue is associated with extensive prior grain boundary migration. It invariably leads to grain refinement and work softening. An experimental setup and computer code was developed to utilize synchrotron radiation for fully automatic orientation mapping.

14928 **(DOE/ER/45294—T1) Brittle to ductile transition to cleavage fracture: Progress report, April 1-November 30, 1987.** Argon, A.S. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). 1987. Contract FG02-87ER45294. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004074/JAW.

The brittle-to-ductile transition in cleavage fracture in single crystals is being studied both experimentally and theoretically as the key problem in such fracture transitions exhibited by intrinsically brittle (cleavable) polycrystalline solids. The intrinsic process that governs the transition is thermally assisted dislocation emission from the tips of atomically sharp cleavage cracks at the verge of propagation, which then provide effective crack tip shielding and blunting. All other phenomena known to influence the transition in fracture, such as shielding provided through the polarization of free dislocations in the distant field, micro-crack initiation, etc., are identified as extrinsic processes that merely shift the basic transition to lower temperatures or higher crack velocities, or consider formation of cracks with the required velocity for cleavage propagation.

14929 **(DOE/ER/45297—8) Brillouin scattering from collective spin waves in magnetic superlattices.** Hillebrands, B.; Boufelfel, A.; Falco, C.M.; Baumgart, P.; Guentherodt, G.; Zirngiebl, E.; Thompson, J.D. (Arizona Univ., Tucson (USA); Koeln Univ. (Germany, F.R.). 2. Physikalisches Inst.; Los Alamos National Lab., NM (USA)). 1987. Contract FG02-87ER45297;W-7405-ENG-36. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005347/JAW.

We report on the observation and the analysis of collective magnetostatic spin-wave excitations in magnetic superlattices. The influence of interface anisotropies, which can become dominant for small modulation wavelengths, is discussed. For the system Fe/Pd we show that Brillouin spectroscopy experiments in combination with the measurement of the saturation magnetization by a SQUID magnetometer give evidence for a magnetic polarization of the Pd spacer layers, as well as for a small negative out-of-plane interface anisotropy constant of K/sub s/ = -0.15 erg/cm^2. 22 refs., 5 figs., 1 tab.

14930 **(DOE/ER/45297—9) Atomic monolayer metallic superlattices.** Makous, J.L.; Falco, C.M. (Arizona Univ., Tucson (USA)). 1987. Contract FG02-87ER45297. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005348/JAW.

We report the fabrication of a superlattice consisting of alternating single atomic planes of Mo and Ta. This is the first metallic superlattice fabricated with monolayer modulation. This superlattice is the lower limit of a set of superlattices with wavelengths modulated by integer numbers of atomic planes of Mo and Ta. These superlattices retain structural coherence and exhibit metallic resistivity behavior over the entire range of wavelengths down to this monolayer limit. The results reported here contrast with structural and transport behavior observed in other metal-metal superlattices previously studied.

14931 **(DOE/ER/45308—1) The role of composition and microstructure gradients on weld metal properties and behavior: Progress report for the period of June 1, 1987 to December 31, 1987.** Matlock, D.K.; Olson, D.L. (Colorado School of Mines, Golden (USA). Center for Welding and Joining Research). Jan 1988. Contract FG02-87ER45308. 68p. (MT-CWR—088-003). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004956/JAW.

The effects of weld metal compositional and microstructural gradients on phase transformations, microstructural stability, and mechanical properties are considered from a fundamental basis in weld metal alloys which are primarily austenitic (e.g., stainless steels). Models which incorporate compositional gradients are developed to predict the resulting weld metal properties. The mechanical properties of weld metals are modeled based on composite theory in which individual weld metal zones are considered as discrete elements within a composite structure. 23 figs.

14932 **(DP-MS—87-14) Irradiation effects in metals.** Caskey, G.R. Jr. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 7p. (CONF-870466—6). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004272/JAW.

From International conference on environmental degradation of engineering materials; University Park, PA, USA (13 Apr 1987).

Recent irradiation damage studies on structural alloys have been reviewed to highlight select research efforts currently of interest. The literature on irradiation damage and irradiation effects is extensive, conference proceedings alone accounting for many hundreds of papers. Consequently, literature citations have been included only when directly relevant to topics covered in the present conference, namely; swelling and cavity formation; creep, fracture and helium embrittlement. 14 refs.

14933 **(ECRC/M—2181) Corrosion of mild steel in ozonised air-conditioning cooling tower water.** Bird, T.L. (Electricity Council Research Centre, Capenhurst (UK)). Aug 1987. 16p. Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.

A field trial in an open-evaporative cooling water system resembling those used for air-conditioning units has shown that ozonisation of the water is ineffective in protecting mild steel from corrosion. This finding is at variance with reported favourable experience in the USA. In the trial, the corrosion resistance of steel test coupons in water treated with sodium nitrite - a conventional corrosion inhibitor - was more than five times better than in ozonised water. The results were corroborated by electrochemical measurements. Ozone is not recommended for use for air-conditioning cooling system water, therefore, even though it is an effective biocide against the bacteria responsible for Legionnaires' disease.

14934 **(IAE—4256/11) Helium behaviour in tungsten during high temperature irradiation out of glow discharges.** Chernikov, V.N.; Zakharov, A.P.; Merkulenko, N.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 36p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700174/JAW.

Electron-microscopic investigation into the depth on near-surface structure of monocrystalline tungsten formed under high-intense irradiation out of glow discharge in helium at T=2/3 T/sub melt/ was carried on in detail using the transverse cross section method. Near the surface a layer of intense helium swelling (IS) to a depth δ — 5000 A at 25-50% swelling coefficient was discovered. Screw dislocations of deformation origin were revealed in the crystal volume. Physics is considered and phenomenology of IS layer formation is developed. Quasiequilibrium helium concenrations in solid tungsten solution in the IS region were estimated: from 3.5×10^{-6} to 7×10^{-7} ata. Assumption of concentration dependence of high-temperature coefficient of helium diffusion in tungsten was stated. Problems of helium gas permeability on irradiation out of glow discharge were considered. 53 references, 6 figures.

14935 **(IAE—4319/11) Influence of grain boundary phosphorus segregation on hydrogen embrittlement in steel.** Platonov, P.A.; Amaev, A.D.; Nikolaev, V.A.; Tursunov, I.E.; Krasikov, E.A.; Levit, V.I.; Nikitin, S.V.; Biryukov, A.Yu.; Gorskij, K.V.; Popov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700176/JAW.

Experimental investigation into the effect of grain-boundary impurity segregations on hydrogen embrittlement of pearlite steel was carried on. It is shown that thermal ageing during 10^3 and 10^4 h and subsequent hydridation result in complete loss of ductility. At that phosphorus and carbon impurity aggregations form casing synergism between thermal and hydrogen embrittlements. The similar interaction causing the formation of intergranular cracks with out applying external stress can result in fracture of idle steel. The determining effect on the fracture mechanism of hydrogen interaction with intergranular microstructural heterogeneities (in particular, impurity segregations) is noted. 23 references, 15 figures, 3 tables.

14936 (INIS-BR—748, pp 120) **Reactions between gas and metals.** Rodrigues, J.A.; Bernardi, M.I.B.; Botta Filho, W.J.; Akune, K. (Sao Carlos Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14937 (INIS-BR—748, pp 176) **Electronic structure of the (GaAs)/sub 1-x/Ge/sub 2x/ metastable alloys.** Koiller, B.; Davidovich, M.A.; Osorio, R. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil; Brasilia Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14938 (INIS-BR—748, pp 21) **Study of the influence of chemical ordering on the density of states in α-ZrNi.** Duarte Junior, J.; Frota-Pessoa, S. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14939 (INIS-BR—748, pp 23) **Production and characterization of Sn/sub 1-x/ Mn/sub x/ amourphous alloys, $0.10 \leqq x \leqq 0.90$.** Drago, V.; Saitovitch, E.M.B. (Santa Catarina Univ., Florianopolis, Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14940 (INIS-BR—748, pp 23) **Moessbauer study of Sn/sub 1-x/ Mn/sub x/ amourphous alloys - I: paramagnetic phase.** Drago, V.; Saitovitch, E.M.B. (Santa Catarina Univ., Florianopolis, Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14941 (INIS-BR—748, pp 24) **Moessbauer study of Sn/sub 1-x/ Mn/sub x/ amourphous alloys - II: magnetic phase.** Drago, V.; Saitovitch, E.M.B. (Santa Catarina Univ., Florianopolis, Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14942 (INIS-BR—748, pp 33) **Self-consistent calculation of hydrogen adsorption in metallic chain.** Melo, C.P. de; Santos, M.C. dos; Kirtman, B. (Pernambuco Univ., Recife, Brazil; California Univ., Santa Barbara). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14943 (INIS-BR—748, pp 35) **Study of energy level self-interaction effects in transition metals.** Lino, A.T.; Takahashi, E.K.; Castineira, J.L.P.; Pereira, E.N. (Universidade Federal de Uberlandia, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14944 (INIS-BR—748, pp 74) **Ferromagnet of potts in semi-infinite single cubic lattices: criticality.** Silva, L.R. da; Tsallis, C.; Sarmento, E.F. (Rio Grande do Norte Univ., Natal, Brazil; Alagoas Univ., Maceio, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14945 (INIS-BR—748, pp 74) **Criticality of a semi-infinite volume anisotropic Heisenberg ferromagnet.** Costa, U.M.S.; Mariz, A.M.; Tsallis, C. (Alagoas Univ., Maceio, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14946 (INIS-BR—748, pp 82) **Critical resistivity of Pd_2 MnSn and Pd_2 MnSb Heusler alloys.** Fraga, G.L.F.; Pureur, P.; Schreiner, W.H.; Kunzler, J.V.; Brandao, D.E. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14947 (INIS-BR—748, pp 109) **Magnetic properties of lithium ferrites diluted by gallium.** Domingues, P.H.; Amorim, H.S. de; Souza Barros, F. de; Maria Neto, J. (Rio de Janeiro Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14948 (INIS-BR—748, pp 109) **Study of the creation and relieving of defects by mechanical deformation in ferromagnets using Barkhausen spectroscopy.** Sommer, R.; Livi, F.P. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14949 (INIS-BR—748, pp 110) **Study of magnetic behavior of CuMn alloy with high concentration of Mn.** Ramos, S.M.M.; Schreiner, W.H.; Schaf, J. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14950 (INIS-BR—748, pp 110) **Magnetic properties of the Nd_2(Fe/sub 1-x/T/sub x/)$_{14}$B ferromagnetic alloys.** Gomes, V.V.B.; Missell, F.P. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14951 (INIS-BR—748, pp 111) **Magnetic properties of lithium ferrites diluted by aluminium and gallium.** Maria Neto, J.; Domingues, P.H.; Souza Barros, F. de. (Rio de Janeiro Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14952 (INIS-BR—748, pp 111) **Transfer of excitations in the $CsNiF_3$.** Terrile, M.C. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14953 (INIS-BR—748, pp 112) **Magnetoelastic properties of $ErFe_2$.** Schmidt, J.E.; Cunha, J.B.M. da; Viccaro, P.J. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14954 (INIS-BR—748, pp 127) **Formation of located moments in rare impurities in gadolinium: Peiod effect.** Leal, C.E.; Troper, A. (Rio de Janeiro Univ., Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14955 (INIS-BR—748, pp 128) **Influence of iron addition in $CeAl_2$ Kondo system.** Takeushi, A.Y.; Cunha, S.F. da. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14956 (INIS-BR—748, pp 128) **Relaxation of europium impurities of intermediate valence.** Foglio, M.E. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14957 (INIS-BR—748, pp 130) **Estimation of purely thermal and volumetric contributions for the gradient of electric field (CCE) in In_2Bi and In_4Bi_3 compounds.** Fries, S.G.; Maciel, A.; Jornada, J.A.H. da. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14958 (INIS-BR—748, pp 131) **Study of the electronic contribution to the gradient of the electric field in the nucleus of an Fe impurity in hcp Zr without use of axial symmetry.** Petrilli, H.M.; Frota-Pessoa, S. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14959 (INIS-BR—748, pp 131) **Application of Moessbauer spectroscopy for magnetism study of Ti/sub 1+-x/ Fe/sub 2-+x/ in laves phase limits.** Rezende, M.F.S.; Mansur, R.A. (Minas Gerais Univ., Belo Horizonte, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14960 (INIS-BR—748, pp 132) **Formation and thermal evolution of Fe/sub n/C/sub m/ in Fe implantated with C.** Oliveira, L.S. de; Silva, M.T.X.; Viccaro, P.J. (Santa Catarina Univ., Florianopolis, Brazil; Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14961 (INIS-BR—748, pp 132) **Measurements of hyperfine interactions in C15 compounds.** Panarotto, E.; Saitovitch, H. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14962 (INIS-BR—748, pp 133) **Study of Pd/sub x/ Au/ sub 1-x/ electronic structure by XPS (x-ray photoelectron spectroscopy).** Nascente, P.A.P.; Castro, S.G.C. de. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14963 (INIS-BR—748, pp 134) **Probability of adhesion to metallic surface.** Yoshida, Makoto; Oliveira, L.N. de. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14964 (INIS-BR—748, pp 135) **Spectrum of the vibrational excitation of gases adsorbed in transition metals.** Lavarda, F.C.; Laks, B. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14965 (INIS-BR—748, pp 132) **Analysis of hyperfine field behavior in Ni/sub 2/ Mn Sn Heusler type alloys with In impurity in the ^{119}Sn Moessbauer isotope.** Ramos, S.M.M.; Fraga, G.L.F.; Vasquez, A.; Brandao, D.E. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14966 (INIS-BR—748, pp 160) **Band dislocation of plasmons in Ag^0 as a function of the position of the 4f Eu^{3+} level by reducing agents in glasses.** Malta, O.L.; Santa Cruz, P.A.; Sa, G.F. de. (Pernambuco Univ., Recife, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14967 (INIS-BR—748, pp 166) **Nuclear spin-lattice relaxation in the KNi/sub x/ Mg/sub 1-x/ F_3 diluted magnetic system.** Engelsberg, M.; Aguiar, J.A.O. de; Franco Junior, A. (Pernambuco Univ., Recife, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14968 (INIS-BR—748, pp 167) **Study of UBe_{13} and UPt_3 heavy-fermion systems by EPR.** Gandra, F.G. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14969 (INIS-BR—748, pp 167) **Effect of crystal field in resonance spectra of intermediate valence compounds (VI).** Venegas U, P.; Barberis, G.E. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14970 (INIS-BR—748, pp 167) **Studies of NMR and magnetic nuclear relaxation of Y_9 Co_7.** Figiel, H.; Barata, A.C.; Guimaraes, A.P. (Academy of Mining and Metallurgy, Krakow, Poland; Espirito Santo Univ., Vitoria, Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14971 (INIS-BR—748, pp 185) **Metallization of aluminium.** Arcaro, C.M.; Mammana, A.P.; Braga, E.S.; Kobayashi, S.; Tatsch, P.J.; Almeida, L.A.C. de; Anderson, R.L. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14972 (INIS-BR—748, pp 135) **Study of reaction kinetics and formation of NbC.** Gama, S. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14973 (INIS-BR—748, pp 53) **Structure determination of amorphous metal alloys.** Bezerra, G.H. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14974 (INIS-BR—748, pp 120) **Analysis of surface effects produced by cathodic hydrogeneration in stainless steels by x-ray diffraction.** Saavedra, A. (Instituto Militar de Engenharia, Rio de Janeiro, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14975 (INIS-BR—748, pp 119) **Stresses in an austenitic stainless steel welded joint.** Kuramoto, N.K.; Guimaraes, A.S.; Miranda, P.E.V. de; Pascual, R. (Rio de Janeiro Univ., Brazil; Instituto Militar de Engenharia, Rio de Janeiro, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14976 (INIS-BR—748, pp 135) **Recrystallization texture in 3003 and 1100 commercial type aluminium tubes.** Lima, N.B. de; Padilha, A.F.; Imakuma, K. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14977 (INIS-BR—748, pp 21) **Aftereffects of magnetic permeability in Co enriched amorphous alloys with magnetostriction near zero.** Rezende, A.T. de; Turtelli, R.S. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14978 (INIS-BR—748, pp 22) **Anisotropy and magnetostriction in $Co_{75}Si_{15}B_{10}$ amorphous alloy.** Santos, A.D. dos; Severino, A.M.; Missell, F.P. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14979 (INIS-BR—748, pp 22) **Magnetic amorphous alloys with low magnetostriction - behavior under tension and thermal treatment.** Severino, A.M.; Santos, A.D. dos; Missell, F.P. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14980 (INIS-BR—748, pp 109) **Counter current method: extension and experimental results.** Jardim, R.F.; Santos, C.; Laks, B. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14981 (INIS-BR—748, pp 121) **Hydrogen solubility in NbTi46%-p. alloy.** Florencio, O.; Silva, J.R.G. da; Rodrigues, J.A. (Universidade Estadual de Maringa, Brazil; Sao Carlos Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14982 (INIS-BR—748, pp 127) **Study of Y and Sc diluted magnetic alloys.** Pureur Neto, P. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

14983 (INIS-mf—11004) **Collective-pinning properties of superconducting a-Nb/sub x/Ge and a-Mo/sub x/Si films. Observations of structural phase transitions in the flux-line lattice.** Woerdenweber, R. (Rijksuniversiteit Leiden (Netherlands)). 26 Feb 1987. 122p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700211/JAW.

This thesis describes a study of superconducting flux pinning in amorphous NbGe and MoSi films of various compositions and thickness. Amorphous NbGe and MoSi alloys belong to the weak-coupling type-II superconductors in the extreme dirty limit. This feature enables to determine several important superconducting parameters from well-known theoretical expressions. It is also responsible for the weak pinning, which is necessary to observe the two-dimensional collective pinning properties according to the Larkin-Ovchinnikov theory. 159 references, 42 figures, 4 tables.

14984 (IPEN-Pub—105) **Dynamical properties of aluminium from experimental dispersion relations.** Salles Filho, J.B.V.; Fulfaro, R.; Vinhas, L.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). May 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700240/JAW.

Measurements of phonon dispersion relations of aluminium along the high symmetry directions were performed by coherent inelastic scattering of thermal neutrons technique. All measurements were taken at room temperature using the IPEN triple axis neutorn spectrometer. The results obtained with accuracy are in good agreement with the published data. The dispersion relations were calculated theoretically within the framework of Born-von Karman and Axially Symmetric models, including interactions up to the fifth nearest shell of atoms. The elastic constants were determined using the values of sound propagating velocity obtained directly from the dispersion relations along of high symmetry directions of the crystal. Applying theoretical models the force constants of aluminium were also determined. From these data several physical properties of the metal can be obtained.

14985 (JAERI-M—87-176) **Effects of aging and test temperature on tensile and fatigue properties of nickel-base heat-resistant alloy.** Tsuji, Hirokazu; Suzuki, Tomio; Nakajima, Hajime. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 36p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751997/JAW.

A series of tensile and strain controlled low-cycle fatigue tests were conducted at the temperatures ranging from room temperature (RT) to 900 deg C on a nickel-base heat-resistant alloy, Hastelloy XR-II, which is one of the candidate alloys for applications in the process heating high-temperature gas-cooled reactor (HTGR). Materials were tested in the solution annealed as well as in the pre-aged condition where aging consisted of isothermal exposure at 900 deg C for the period of 1000 h. In those tests the effects of aging and test temperature on tensile and fatigue properties were investigated. The ductility minimum point was observed near 600 deg C in the solution annealed condition. On the other hand, the ductility of the aged materials was reduced excessively at RT, and increased with increasing test temperature. At and below 700 deg C, the fatigue lives of the aged materials were shorter than those of the solution annealed ones. The tendency was interpreted through the fractographic and metallographic features of the fatigued specimens. The fatigue lives estimated from tensile properties using the method proposed by Manson were compatible with the results of fatigue tests under the test conditions employed.

14986 (LA-UR—87-3717) **Developments in the TEM [Transmission Electron Microscopy] examination of Pu and Pu alloys.** Zocco, T.G.; Rohr, D.L. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-871124—10). NTIS, PC A02; 3; GPO Dep. Order Number DE88003177/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Microstructural characterization of plutonium utilizing Transmission Electron Microscopy (TEM), has previously been shown to be difficult because of the extreme toxicity and high oxidation rate of plutonium metal. Recent developments in plutonium sample preparation have shown that TEM foils of both alpha and delta phases may be prepared without the use of inert atmospheric systems on complex preparation devices. Using standard electropolishing techniques, samples may be produced which yield important microstructural data on plutonium and plutonium alloys. 15 refs., 4 figs.

14987 (LA-UR—87-3888) **Optical measurements of surface oxide layer formation on metal films.** Scott, M.L. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-8710254—1). NTIS, PC A02. Order Number DE88003163/JAW.

From 19. annual symposium on optical materials for high power lasers; Boulder, CO, USA (26 Oct 1987).

We have employed two optical techniques which give complementary indications of the formation of monolayers of oxide on freshly evaporated aluminum and silicon thin films. Visible ellipsometry is utilized to observe the growth of the initial monolayer of oxide on these films. From these data, we deduce the pressure and coverage dependence as well as the growth rate for the initial monolayer arising from these surface reactions. In addition, extreme ultraviolet (xuv) reflectance vs angle of incidence measurements at 58.4 nm wavelength clearly indicate the growth of oxide on the surface of our freshly deposited aluminum and silicon films as well. We have utilized this reflectance data to deduce the optical constants of aluminum and silicon at 58.4 nm. We find that previous xuv measurements of these optical constants were hampered by the presence of oxides. We also determined that the xuv reflectivity performance of aluminum films freshly deposited in our uhv system does not degrade appreciably when stored for four weeks in a helium atmosphere of 2×10^{-9} Torr. 11 refs., 7 figs., 1 tab.

14988 (LBL—23263) Scanning tunneling microscopy of silver, gold, and aluminium monomers and small clusters on graphite. Ganz, E.; Sattler, K.; Clarke, J. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 23p. (CONF-8707142—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003871/JAW.

From 2. international conference on scanning tunneling microscopy/spectroscopy; Oxnard, CA, USA (20 Jul 1987).

We have deposited small numbers of atoms of silver, gold, and aluminum onto cleaved graphite substrates in ultra high vacuum. Using a scanning tunneling microscope, we have observed monomers, groups of monomers, dimers and a trimer. The adsorption sites and atomic spacings are determined by direct observation. 21 refs., 7 figs.

14989 (LBL—24129) Microstructure and properties of rare earth magnets. Ramesh, R.; Chen, J.K.; Rabenberg, L.K.; Thomas, G. (Lawrence Berkeley Lab., CA (USA); Texas Univ., Austin (USA). Center for Materials Science and Engineering). Nov 1987. Contract AC03-76SF00098. 55p. (CONF-8710251—1). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004554/JAW.

From Symposium on hard and soft magnetic materials with applications; Cincinnati, OH, USA (10 Oct 1987).

In this paper an attempt has been made to review and identify the major microstructural and microanalytical constituents of Co-Sm and Fe-Nd-B magnets which differ fundamentally in their magnetization reversal mechanism. From these observations some suggestions for future directions are outlined. 78 refs., 23 figs.

14990 (MLM—3479) Metal modification for improved glass-ceramic to metal seals: 1. Auger results on ion implantation and vapor deposition films. Moddeman, W.E.; Cassidy, R.T.; Birkbeck, J.C.; Barton, B.D.; Bailey, J.A.; Salerno, R.F.; Wittberg, T.N. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 29 Jan 1988. Contract AC04-76DP00053. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005244/JAW.

Auger electron spectroscopy was used to characterize the oxide passivation layers on Inconel 718 and 304L stainless steel coupons modified by one of the following techniques: (1) $^{16}O^{+}$ ion implantation, (2) vapor deposition of an aluminum coating followed by oxygen plasma treatment, or (3) vapor deposition of an aluminum coating followed by air oxidation at 650°C. The results showed that a passivated oxide layer was created in all cases. However, air oxidation at 650°C of the vapor-deposited aluminum coating has the best potential for obtaining an oxide layer thick enough (a minimum of 2000 A) to protect the metal during the sealing cycle and, ultimately, to produce a better glass-ceramic to metal seal. 12 refs., 6 figs.

14991 (N—88-11749) Slip casting and extruding shapes of rhenium with metal oxide additives. Part 2: Development of grain stabilized rhenium parts for resistojets. Final report. Barr, F.A.; Page, R.J. (Page (R.J.) Co., Santa Ana, CA (USA)). Nov 1987. 22p. (NASA-CR—180851; NAS—1.26:180851). NTIS, PC A03/MF A01.

The adaptation of the powdered particle process used for pure metal oxides to the coprocessing of rhenium oxides suitable to produce pure miniature resistojet hardware has been successful. Both slip casting and extrusion processes were used. The metal oxide ZrO_2 was stabilized into the cubic phase with Y_2O_3, for use as a potentially grain stabilizing additive to rhenium. Straight meter long tubing in two sizes are reported. Tubing suitable for resistojet ohmic heater use of fully fired dimensions of nominally 3.8 mm o.d. x 2.2 mm i.d.. and 1.26 mm o.d. x .45 mm i.d. with 0, 0.5, 1.0 and 5.0% zirconia additives were produced for further study. Photomicrographs of these are discussed. The addition of the metal oxide zirconia to rhenium resulted in more dense and less porous parts. The additions of phase stabilized zirconia most likely act as a sintering aid. Tubes of varying diameter were slip cast which were representative of miniature pressure cases.

14992 (N—88-11756) Mechanical response of unidirectional boron/aluminum under combined loading. Becker, W.; Pindera, M.J.; Herakovich, C.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Oct 1987. 318p. (NASA-CR—181477; NAS—1.26:181477; VPI-E—87-17; CCMS—87-06). NTIS, PC A14/MF A01.

Three test methods were employed to characterize the responses of unidirectional Boron/Aluminum metal matrix composite material under monotonic and cyclic loading conditions, namely: Iosipescu Shear, Off-Axis Tension and Compression. The characterization of the elastic and plastic response includes the elastic material properties, yielding and subsequent hardening of the unidirectional composite under different stress ratios in the material principal coordinate system. The elastic response is compared with the prediction of the transformation theory, based on the far field stress, the Pagano-Halpin Model, and finite element analysis. Yield loci generated for different stress ratios are compared for the test methods, taking into account residual stresses and specimen geometry. Subsequently, the yield locus for in-plane shear is compared with the prediction of an analytical, micromechanics model. The influence of the scatter in the experimental data on the predicted yield surface is also analyzed. Lastly, the experimental material strengths in tension and compression are correlated with the Maximum Stress and the Tsai-Wu failure criterion.

14993 (N—88-11859) Consortium for materials development in space. Technical section. Annual report, 15 September 1986-14 September 1987. (Alabama Univ., Huntsville (USA)). Sep 1987. 103p. (NASA-CR—181508; NAS—1.26:181508). NTIS, PC A06/MF A01.

Several topics related to materials development in space are discussed. Physical vapor transport crystal growth, the mass spectroscopic facility, surface coatings and catalyst production by electrodeposition, mass transfer by diffusion, electrooptical organic materials, and high temperature superconductors are among the topics covered.

14994 (ND-R—1155(S)) Validation of CANSWEL-2 for Zircaloy-4 in the alpha-phase region, using BNL single rod burst data. Haste, T.J. (UKAEA Risley Nuclear Power Development Establishment). Oct 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750924/JAW.

Recent BNL measurements of rupture strain in the alpha-phase region against azimuthal temperature difference for a batch of Zircaloy-4 cladding supplied by Westinghouse have been analysed using CANSWEL-2. Satisfactory agreement has been found between the code calculations and experimental results. Sensitivity studies have shown the importance of initial wall thickness variations if azimuthal temperature gradients are low, less than 10°C. The observed scatter in the data may be explained by the variations in thickness and by variations on local ductility, both within the range of other recent measurements.

14995 (NIIAR—30(711)) Changes in mechanical properties of the OKh16N15M3B steel in the temperature range of radiation-induced swelling. Neustroev, V.S.; Golovanov, V.N.; Povstyanko, A.V.; Shamardin, V.K. (Nauchno-Issledovatel'skij i Konstruktorsko-Tekhnologicheskij Inst. Teploehnergeticheskogo Priborostroeniya, Smolensk (USSR)). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700271/JAW.

Presented are the results of investigations of both swelling and mechanical properties of the fuel element cans of BOR-60 reactor of the 0Kh16N15M3B steel after austenitization. The dose-temperature dependences have been plotted swelling and radiation-induced porosity parameters as well as for mechanical properties of the above steel. Interpretation of changes in some 0Kh16N15M3B steel mechanical properties with dose and temperature has been proposed based on Orovan's mechanism and on that for crack nucleation with voids present. 6 references, 10 figures.

14996 (ORNL/TM—9783, pp 13-14) **Modern atomistic theories of fracture.** Daw, M.S.; Baskes, M.I. (Sandia National Labs., Livermore, CA). 1985. NTIS, PC A09/MF A01. Order Number DE86001859/JAW. (CONF-851104—Summs.).

From Fundamental aspects of fracture; Gatlinburg, TN, USA (4 Nov 1985).

Two fundamental problems currently prevent atomistic calculations of fracture from becoming the powerful tool that it could be. The first difficulty is in describing the internal forces in a realistic way. The second lies with the boundary conditions imposed on the calculation. The two fundamental difficulties will be reviewed in depth. The EAM will be explored as an alternative to pair potentials. The effects of boundary conditions and possible solutions will be investigated.

14997 (ORNL/TM—9783, pp 15-16) **Interatomic potential descriptions of atomic processes in metals.** Carlsson, A.E. (Washington Univ., St. Louis, MO). 1985. NTIS, PC A09/MF A01. Order Number DE86001859/JAW. (CONF-851104—Summs.). Contract FG02-84ER45139.

From Fundamental aspects of fracture; Gatlinburg, TN, USA (4 Nov 1985).

Attempts to model the bonding energy in metallic media with interatomic potentials have led to the use of a bewildering variety of potentials, depending on both the type of problem under consideration and the properties of the local atomic environment. The paper will focus on the problem dependence of the potentials. The types of problems under consideration may be represented by two extreme varieties: (1) bond-breaking problems. These problems include vacancy, void, and surface formation, and to a lesser extent, dislocation and grain boundary formation. (2) Constant-Volume Problems. These include, for example, crystal structure energy differences, phonon dispersion curves, vacancy and grain boundary relaxation energies, and liquid structure factors. Little free volume is created on a local scale although atoms may rearrange themselves around voids. The atomic rearrangements lead to a change in band-shape rather than band-width. Although the limits described under (1) and (2) are physically quite distinct, they can be understood within a common theoretical framework based on explicit many-atom cluster interactions.

14998 (ORNL/TM—9783, pp 17-18) **Structural prediction with the tight binding bond model.** Pettifor, D.G. (Imperial College, London, England). 1985. NTIS, PC A09/MF A01. Order Number DE86001859/JAW. (CONF-851104—Summs.).

From Fundamental aspects of fracture; Gatlinburg, TN, USA (4 Nov 1985).

The atomic structure of a crack tip is crucial for determining whether a material is brittle or ductile and how the crack behaves in the presence of external chemical species. Unfortunately, however, the computer simulation of structure is very sensitive to the particular choice of interatomic interaction, so that a theoretical model must be chosen which is compatible with the system under consideration. In this talk a microscopic, quantum-mechanical tight-binding model is presented which is accurate enough to predict trends in structural behavior amongst the binary compounds of transition metals with metalloid elements, yet simple enough to offer the possibility of simulating defects and their interaction with impurity elements.

14999 (ORNL/TM—9783, pp 19-20) **Electronic theory for hydrogen embrittlement of bcc transition metals.** Masuda-Jindo, K. (Tokyo Institute of Technology, Yokohama, Japan). 1985. NTIS, PC A09/MF A01. Order Number DE86001859/JAW. (CONF-851104—Summs.).

From Fundamental aspects of fracture; Gatlinburg, TN, USA (4 Nov 1985).

The study of hydrogen enhanced fracture of metals and alloys has received a great deal of interest in recent years. The purpose of the present paper is to investigate the interaction between the solute hydrogen and crack tips in bcc transition metals using a microscopic electronic theory. The authors will show that the electronic interaction energies E/sub bin/ between the hydrogen and the crack are quite important: E/sub bin/ depends strongly on the applied stress as well as on the geometry of the crack. They also estimate the energy E/sub br/ required to break the metallic bonding near the crack tips in the presence (and absence) of hydrogen atoms.

15000 (ORNL/TM—9783, pp 21) **Energetics of structural relaxations, dynamics and transport at interfaces.** Landman, U. (Georgia Institute of Technology, Atlanta). 1985. NTIS, PC A09/MF A01. Order Number DE86001859/JAW. (CONF-851104—Summs.).

From Fundamental aspects of fracture; Gatlinburg, TN, USA (4 Nov 1985).

Extended defects such as external surfaces, grain boundaries, cracks and other interfaces modify electronic, crystallographical, dynamical and mechanical properties of solid materials. The energetics underlying structural relaxations, dynamical properties and transport at the vicinity of interfaces will be discussed in the light of recent theories based on total energy minimization methods and molecular dynamics simulations.

15001 **(ORNL/TM—10508) The intergranular segregation of boron in substoichiometric Ni_3Al.** Choudhury, A. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 317p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88004783/JAW.

The intermetallic compound Ni_3Al offers promise as a material for high temperature applications. In addition to its unusual property of increasing strength with temperature (until ~700°C), it has excellent corrosion and oxidation resistance. Microalloying the alloy with boron has been shown to be dramatically effective in improving its inherent intergranular brittleness. This improvement results from the strong tendency of boron to segregate to the grain boundaries of Ni_3Al. This research deals with the study of the segregation behavior of boron. Auger electron spectroscopy was chosen as the technique adopted to study this segregation. The strong effect of segregant level on the grain boundary strength level can be controlled by thermal history variations and by variations in the level of solute in the bulk. Cathodic hydrogen charging was shown to be a potent tool in opening up other wise cohesive boundaries for analysis. The effective binding energy of boron at the grain boundaries of Ni_3Al was calculated from experimental data; it was found to vary between 0.2 and 0.45 eV. Kinetics of segregation have been investigated; the present set of kinetic studies were shown to be inadequate to find a diffusion coefficient and that temperatures lower than those studied here need to be used. As an associated investigation, a set of elemental standards were developed for the particular scanning Auger microprobe used in this study. 141 refs., 94 figs., 26 tabs.

15002 **(PB—88-855085/XAB) Shape-memory alloys. January 1975-November 1986 (citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-November 1986.** (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 162p. NTIS PC N01/MF N01.

This bibliography contains citations concerning experiments on shape-memory effects of various alloys. Alloys studied include nickel, tin, indium, lead, copper, and titanium. Studies include crystallography, properties, processing, alloying, and mechanisms that result in shape-memory effects. (This updated bibliography contains 327 citations, none of which are new entries to the previous edition.)

15003 **(PB—88-855093/XAB) Shape memory alloys. December 1986-December 1987 (citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for December 1986-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 49p. NTIS PC N01/MF N01.

Supersedes PB—87-851473.

This bibliography contains citations concerning experiments on shape-memory effects of various alloys. Alloys studied include nickel, tin, indium, lead, copper, and titanium. Studies include crystallography, properties, processing, alloying, and mechanisms that result in shape memory effects. (This updated bibliography contains 79 citations, all of which are new entries to the previous edition.)

15004 **(PNL-SA—14825) Calculated solute segregation kinetics related to irradiation assisted stress corrosion cracking.** Simonen, E.P.; Jones, R.H. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 9p. (CONF-870839—9). NTIS, PC A02. Order Number DE88003423/JAW.

From 3. international symposium on environmental degradation of materials in nuclear power systems: water reactors; Traverse City, MI, USA (30 Aug 1987).

Solute segregation kinetics were calculated for neutron irradiation conditions relevant to irradiation assisted stress corrosion cracking (IASCC) and ion irradiation conditions relevant to irradiation-induced solute segregation experiments. Requirements for near-monolayer coverage of surfaces or grain boundaries were determined based on assumptions of the McLean isotherm, enhanced diffusion kinetics, and self-interstitial-solute binding. Predicted nonequilibrium segregation driven by irradiation was consistent with reported measurements of ion-induced segregation for reasonable assumed values of interstitial-solute binding energy. Near-monolayer boundary concentrations were predicted for LWR temperatures and at doses near the threshold for IASCC. The calculations indicate that undersized elements such as phosphorus, sulfur and silicon are expected to segregate and possibly influence IASCC. The nonequilibrium segregation mechanism does not require an enrichment ratio dictated by the McLean isotherm, therefore, undersized solutes that do not segregate thermally may segregate unexpectedly during irradiation. 20 refs., 8 figs., 2 tabs.

15005 **(RFP—4038) Computerized search and sort system for binary phase diagram features.** Selle, J.E. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1986. Contract AC04-76DP03533. 22p. (CONF-8610379—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005144/JAW.

From International conference on user applications of alloy phase diagrams; Orlando, FL, USA (9 Oct 1986).

A computerized search and sort program has been devised to search available binary phase diagram data for prescribed features of interest. Data from the compilations of Hansen, Elliott, Shunk, and Moffatt are summarized in a computerized format for easy retrieval. The program is written in the BASIC language for the IBM PC and compatibles. The database contains information on over 2410 binary systems between 75 elements. A subsequent sort program sorts the information first by diagram type and then alphabetically within each type. The program is useful for conducting searches of binary phase diagram data for the solution of engineering problems involving binary phase diagrams. Searches can be conducted according to diagram features such as type of diagram, number of eutectics, composition or temperature of the lowest melting eutectic, intermediate phases, and the composition or temperature of the maximum amount of terminal solid solubility. A description of the program is presented and examples of its application are discussed. The types of data in the database are described.

15006 **(RFP—4044) Adhesion of PVD titanium coatings to beryllium substrates.** Jankowski, A.F. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 31p. (CONF-870388—17). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005147/JAW.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Mar 1987).

Influencing the adhesive mechanism is the surface condition of the substrate. Along with deposition variables, as substrate temperature, vacuum pressure and coating rate, a mechanical interlocking model of adhesion is proposed. An approximation of the adhesive failure stress is presented based on classical fracture mechanic principles. Incorporated into the model, is an x-ray diffraction texture characterization of the coating microstructure that is shown to vary with the deposition parameters. Experimental stresses to induce bond failure, in an adherence pull test, are compared with those values predicted by the model (which considers a state of plane strain at the coating-substrate interface). 37 refs., 9 figs., 8 tabs.

15007 **(RFP—4051) Fabrication and properties of high-strength uranium-3/4 weight percent titanium alloy large-diameter straight bar stock.** Jackson, R.J.; Thomas, R.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 7 Aug 1987. Contract AC04-76DP03533. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004495/JAW.

High-strength U-3/4 wt % Ti alloy in the form of 3.3-cm-diameter round and straight bar was produced. The starting constituents were derby uranium and titanium sponge. The constituents were vacuum-induction melted at 1350°C and gang cast into preheated molds forming hot-topped ingots 13.3 cm in diameter. After homogenization, the ingots were converted to extrusion billets by cropping the hot-top and sawing the remainder in half. The billets were scalped to a diameter of 12.7 cm. They were then heated in a salt bath at 625°C and forward extruded to a diameter of 4.1 cm. The reduction ratio was 10, and the extrusion constant averaged 25 tons per square inch. 11 refs., 10 figs., 8 tabs.

15008 **(RFP—4160) Development of an ultrasonic measurement system.** Wilhelm, R.F. (Colorado State Univ., Fort Collins (USA). Dept. of Industrial Sciences). Fal 1987. Contract AC04-76DP03533. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014484/JAW.

This paper discusses the development of an ultrasonic measurement system for inspecting the wall thickness of a workpiece of stainless steel 304 while it remains fixtured during machining. The major focus of this report deals with the initial development of the ultrasonic measurement system being performed at Rockwell International, Golden, Colorado. During the initial phase of development the objective was to determine applicability of ultrasonics for performing accurate and reliable measurement of stainless steel specimens.

15009 **(RFP—4179) A computerized search and sort system for binary phase diagrams.** Selle, J.E. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 5 Feb 1986. Contract AC04-76DP03533. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005276/JAW.

A menu driven program provides data on over 2400 binary systems. The data base includes 75 elements and is based on "The Handbook of Binary Phase Diagrams" (1981) by W.G. Moffatt. (WRF)

15010 **(SAND—87-1077C) Corrosion resistance of electrodeposited amorphous Ni-Cr-P alloys.** Guilinger, T.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 17p. (CONF-8710257—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005116/JAW.

From Symposium on metallic glasses; Honolulu, HI, USA (19 Oct 1987).

The outstanding corrosion resistance of amorphous Ni-Cr-P alloys (with >10 at. % Cr and >20 at. % P) prepared by rapid liquid quenching encourages the development of an electroplating bath for the deposition of these alloys. We used a chloride-based bath of Cr(III) and Ni, with hypophosphite or phosphorous acid as the phosphorus source and citrate ion as a complexing agent, to produce such a bath. Anodic polarization and current decay at constant potential were performed on amorphous electrodeposits with varying Cr content in pitting (HCl) and non-pitting (H_2SO_4) electrolytes. The electrodeposits demonstrated outstanding corrosion resistance in both electrolytes, especially when their Cr content exceeded ca. 10 at. %, when compared to crystalline Ni, amorphous NiP, 304 SS, and Hastelloy C-276. 8 refs., 8 figs., 1 tab.

15011 **(SAND—87-1502C) Thermodynamics of wetting by liquid metals.** Yost, F.G.; Romig, A.D. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-871124—38). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003634/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The wetting of metal surfaces by molten solder is usually considered to be driven solely by an interfacial energy imbalance. The effect of chemical reactions on the wetting process is neglected, although the growth of an intermetallic layer in the wetted interface is commonly observed. In this work, the energy release during the incremental advance of a spreading solder droplet due to the interfacial energy imbalance and the formation of the intermetallic layer is calculated. The free energy of formation, ΔG, of the intermetallic layer is shown to be an important driving force for solder wetting. This approach to setting has been applied to three systems, Cu-Sn, Cu-Sb and Cu-Cd. Liquid Sn, Sb and Cd react with solid Cu to form $Cu_6Sn_5(\eta)$, $Cu_2Sb(\gamma)$ and $CuCd_3(\epsilon)$, respectively. 9 refs., 3 figs., 1 tab.

15012 (SAND—87-1565C) Cold cathode electron beam recrystallization of SOI films. Thompson, L.R.; Knapp, J.A.; Moore, C.A.; Collins, G.J. (Colorado State Univ., Fort Collins (USA); Sandia National Labs., Albuquerque, NM (USA); Applied Electron Corp., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-871124—55). NTIS, PC A02. Order Number DE88004655/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

A cold cathode line source electron beam system for forming SOI (Silicon-om-Insulator) films by zone melt recrystallization is described. Possible advantages gained from using a cold cathode electron beam include the controllability of the beam profile and power level, as well as straight-forward scaling to 6 or 8 inch wafers. A computer-based melt width control procedure incorporating feedback to the line intensity from optical observation of the molten zone is also described. This technique allows direct control and adjustment of the melt zone over widths typically from 1 to 3 mm. 5 figs.

15013 (SAND—87-1603C) Laser-induced desorption determinations of surface diffusion on Rh(111). Seebauer, E.G.; Schmidt, L.D. (Sandia National Labs., Albuquerque, NM (USA); Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 1987. Contract AC04-76DP00789. 13p. (CONF-8708209—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005159/JAW.

From LASST-ACSIS conference on interfacial diffusion; New Brunswick, Canada (18 Aug 1987).

Surface diffusion of hydrogen, deuterium and CO on Rh(111) has been investigated by laser-induced thermal desorption (LITD) and compared with previous results for these species on Pt(111) and on other metals. For deuterium in the coverage range $0.02 < \theta < 0.33$, the pre-exponential factor D_0 - 8 x 10^{-3} cm^2/s, with a diffusion activation energy $3.7 < E/sub\ diff/ < 4.3$ kcal/mol. For CO, E/sub diff/ = 7 kcal/mol, but D_0 rises from 10^{-3} to 10^{-2} cm^2/s between $\theta = 0.01$ and 0.40. Values of E/sub diff/ on different surfaces appear to correlate with differences in heats of adsorption in different binding states which form saddle point configurations in surface diffusion. In addition, oxidation reactions on Rh and on several other transition metal surfaces may be limited to CO or H surface diffusion. 30 refs., 3 figs., 1 tab.

15014 (SAND—87-1607C) In situ ultrahigh vacuum friction measurement and wear track analysis of ion implanted 304 stainless steel. Pope, L.E.; Follstaedt, D.M.; Knapp, J.A.; Barbour, J.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-871124—25). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004537/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The dual ion implantation of Ti and C into 304 stainless steel has been found to reduce friction and wear in uhv. The implantation treatment producting this result, 4.6 x 10^{17} Ti/cm^2 (180 keV) followed by 2.0 x 10^{17} C/cm^2 (50 keV), produced TiC precipitates dispersed in an amorphous surface layer. Friction and wear track compositions were measured in situ with a scanning Auger microprobe without removing the pin from the track. This treatment decreased the friction coefficient from 1.2 to 0.6 to 0.8 and the wear track width from 342 μm after 1000 cycles. Relative to unimplanted 304, wear tracks formed in uhv and air on implanted 304 had more N and less C, with O and the metallic elements similar in concentration, in addition to the presence of Ti. Friction coefficients measured in air were less than those in uhv; track composition suggests that oxides or adsorbed moisture (and perhaps hydrocarbons) helped lower the friction in air. 22 refs., 3 figs., 1 tab.

15015 (SAND—87-1719C) Supercooling of silicon and germanium after laser melting. Stiffler, S.R.; Thompson, M.O.; Peercy, P.S. (Sandia National Labs., Albuquerque, NM (USA); Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science). 1987. Contract AC04-76DP00789. 9p. (CONF-871124—53). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004957/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Following pulsed laser melting, supercoolings of 505°K in Si and 430°K in Ge were observed prior to bulk nucleation. These large supercoolings are obtained because of the extremely high thermal quench which follows laser irradiation. Nucleation rates were estimated to be $\sim 10^{29}$ events/m^3/s. Assuming that homogeneous nucleation was achieved, surface energies are estimated to be 0.34 J/m^2 for Si and 0.24 J/m^2 for Ge. These results are in reasonable agreement with traditional homogeneous nucleation experiments sensitive to rates of only $\sim 10^{10}$ events/m^3/s. This laser melting technique is applicable to nucleation studies in a wide variety of materials. 21 refs., 3 figs.

15016 (SAND—87-1882) Cleanliness tests with the Omega Meter: A comparative study for solder flux removal. Lopez, E.P. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 18p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004634/JAW.

This paper reports on a dynamic conductivity test which indicates the effectiveness of solder flux removal. The Omega Meter, a device to measure residual ionic contaminants has been used to measure cleanliness as required by MIL-P-15110 and MIL-P-28809. The cleaning efficiency of seven solvents in removing three basic types of rosin solder fluxes after solder dipping has been evaluated. Results obtained indicate fairly good correlation with those obtained from radiochemical techniques and evaporative rate analysis using the Meseran Surface Analyzer. In this study, using vapor degreasing as the method of cleaning, isopropyl alcohol, trichloroethylene, and 1,1,1 trichloroethane (stabilized) respectively were the best single solvents identified in the removal of types R, RMA, and RA rosin solder fluxes. 3 refs., 6 figs., 3 tabs.

15017 (TPRD/B—0876/R86) Ageing at 1203K of 20/25Nb stainless steel AGR fuel cladding material - microstructural development and its effect on creep properties. Ecob, R.C.; Gilmour, T.C. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1986. 29p. (AGR/FPWG/P—(87)911). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750326/JAW.

The effects of ageing at 1203K for times up to 2.69Ms on the uniaxial constant stress creep properties of a 20/25Nb AGR fuel cladding alloy at 1073 and 1173K have been investigated and correlated with quantitative measurements of the microstructural developments which occur during exposure to both the ageing and creep testing temperatures. A single creep testing stress of 86.6MPa has been used. It is shown that the variation of minimum creep rate can only be explained in terms of the observed NbC particle coarsening at short ageing times (up to 7.44ks). After longer ageing treatments the minimum creep rate tends to decrease with ageing time, which is interpreted as being due to grain growth and, in particular, the onset of secondary recrystallisation. The minimum creep rates displayed by the material are reduced by factors of up to 20 in the presence of partial secondary recrystallisation. It is concluded that the effects of the development of the NbC particle distributions during 1203K ageing on the 1073 or 1173K uniaxial creep endurance of the material are relatively small. Consideration is given to the circumstances in which it might be of more importance, which include longer 1203K ageing treatments, more complex low strain stress/strain cycles. During the ageing treatments and creep tests investigated in the present work, the only significant influences on

creep properties arise from grain growth and secondary recrystallisation.

15018 **(UCRL—96793) Crystallization and glass formation in electron and laser beam irradiated Cu-Zr alloys.** Huang, J.S.; Kaufmann, E.N.; Wall, M.A.; Olsen, B.L. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 9p. (CONF-871124—32). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003390/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Four Cu-Zr alloys, $Cu_{56}Zr_{44}$, $Cu_{50}Zr_{50}$, $Cu_{47}Zr_{53}$, and $Cu_{33}Zr_{67}$, were surface melted with electron and pulsed laser beams to compare their kinetics of nucleation, growth and glass formation. It was observed that the ease of glass formation increased in the order: $Cu_{33}Zr_{67}$, $Cu_{47}Zr_{53}$, $Cu_{56}Zr_{44}$, and $Cu_{50}Zr_{50}$. The nucleation and regrowth produced different metastable phases. At the equiatomic composition, the preferred phase is a CsCl-type (B2) BCC structure. As the composition deviates from this, the preferred phase is either orthorhombic or tetragonal with a much larger unit cell not previously reported in the literature. The maximum growth velocity of these metastable phases was found to be about 0.025 m/s. The slow kinetics are responsible for the ease of glass formation in these systems. 4 refs., 7 figs., 2 tabs.

15019 **(UCRL—97159) Joining of dissimilar materials with the pulsed Nd-YAG laser.** Lingenfelter, A.C.; Westrich, C.N.; Anglin, C.D.; Murchie, J.R. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 7p. (CONF-8711121—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003757/JAW.

From Laser institute of America; San Diego, CA, USA (8 Nov 1987).

The pulsed Nd-YAG laser welding process is an excellent method for joining dissimilar metals. The ability to focus the beam to a small spot size and the capability with a precision CNC positioner to locate the beam very precisely, permits close control of the fusion zone composition. The nature of the pulsed laser process requires that the fusion zone composition exhibit good cracking resistance. Frequently a filler metal can be introduced which will tolerate the dilution from both of the base metals and produce a crack-free weld. Examples are cited to illustrate a number of dissimilar metal combinations. 4 refs., 12 figs.

15020 **Al L/sub 2,3/ and Mg double-ionization emission spectra of dilute Al in Mg alloys.** Zhang, C.H.; Tsang, K.h.; Callcott, T.A.; Ederer, D.L.; Arakawa, E.T. (University of Tennessee, Knoxville, Tennessee 37996). *Physical Review [Section] B: Condensed Matter;* 37: No. 5, 2401-2407(15 Feb 1988).

The Al L/sub 2,3/ spectrum for dilute alloys of Al in Mg, and the Mg L satellite spectrum produced by transitions in atoms with doubly ionized 2p core levels have been measured. The two spectra contain similar features associated with screening of the extra core hole, but are otherwise dissimilar, which suggests that the equivalent-core approximation is not valid. The threshold peak is broadened in both spectra. The Al-impurity spectrum is found to be about 1 eV wider than that of the Mg host. The L_3-L_1 intercore transition in doubly ionized Mg is observed. Finally, a second, weak, high-energy satellite of Mg is observed that may be produced by transitions from the $^1S_0$ state of the doubly ionized core levels. These results provide important new data for comparison with theories of the electronic states of impurity atoms in metals.

15021 **Radiation from oscillating dipoles immersed in a solid, and radiation-induced luminescence.** Crawford, O.H.; Ritchie, R.H. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] A: General Physics;* 37: No. 3, 787-795(1 Feb 1988). Contract AC05-84OR21400.

We have solved Maxwell's equations for a source, consisting of an oscillating dipole, located in a plane-bounded dielectric half space. Formulas are given for the radiation yield from this source in the region outside the dielectric. The medium is characterized by a local, complex dielectric function $\epsilon(\omega) = \epsilon_1(\omega)+i\epsilon_2(\omega)$. The application of these formulas to the analysis of experimental data on luminescence from solids is discussed, and calculations are presented for aluminum, carbon, silver, copper, and gold.

15022 **Temperature dependence of the low-frequency magnetic excitations in USb.** Hagen, M.; Stirling, W.G.; Lander, G.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6061). *Physical Review [Section] B: Condensed Matter;* 37: No. 4, 1846-1859(1 Feb 1988). Contract AC05-84OR21400.

The low-frequency inelastic magnetic response in the type-I fcc antiferromagnet uranium antimonide (USb) has been studied by inelastic neutron scattering in the temperature range from 12 K (0.06T/sub N/) up to 320 K (1.51T/sub N/). At the lowest temperature, the lowest-lying magnetic excitations in USb are a well-defined, dispersive, spin-wave branch. In the temperature range up to 100 K, the principal effect of temperature on this spin-wave branch is to increase the frequencies of the spin waves. However, in the temperature range from 100 to 160 K, these spin waves become progressively damped until at 160 K (0.75T/sub N/) they have collapsed into broad inelastic scattering that peaks only at zero frequency. This scattering is a precursor to the critical scattering which develops around the Neel temperature of T/sub N/ = 212.30 +- 0.05 K. The critical scattering both above and below the Neel temperature has been measured and the critical exponents and amplitude ratios associated with the inverse correlation lengths, the staggered susceptibility, and the characteristic frequency have been determined. These exponents are discussed in terms of a system in a d = 3, n = 3 universality class. In the temperature range above T/sub N/, precursor critical scattering has been observed up to 320 K (~1.5T/sub N/).

15023 **Magnetoresistance in heavy-fermion alloys.** Ruvalds, J.; Sheng, Q.G. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). *Physical Review [Section] B: Condensed Matter;* 37: No. 4, 1959-1968(1 Feb 1988).

The spin-flip scattering of an electron by a pair of adjacent magnetic impurities is calculated in the presence of a magnetic field. In the limit of zero field the pair scattering yields a sharp drop in the low-temperature resistivity whose strength is inversely proportional to T. This process provides an explanation for the anomalous drop in resistivity below $T \leqq 100$ K for UPt_3 and many other heavy-fermion alloys. An external magnetic field is shown to quench this spin-flip contribution, resulting in a positive magnetoresistance for UPt_3 at low temperatures. In conjunction with the single-impurity Kondo scattering, the pair process yields an interesting field dependence for the magnetoresistance at various temperatures and may cause a change of sign in the magnetoresistance as well as in the Hall effect.

15024 **Polarized light scattering study of UPt_3.** Cooper, S.L.; Klein, M.V.; Fisk, Z.; Smith, J.L. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review [Section] B: Condensed Matter;* 37: No. 4, 2251-2253(1 Feb 1988).

We have performed polarized Raman scattering experiments on single-crystal samples of UPt_3 in the temperature range $5\ K \leqq T \leqq 340$ K. Four of the five Raman-allowed phonons have been observed, and their symmetries identified. None of these phonons is seen to demonstrate any anomalous behavior, contrary to previous Raman scattering results. Additionally, quasielastic scattering from spin fluctuations has been observed, having the symmetry of the antisymmetric representation, A_2/sub g/, and displaying a slightly temperature-dependent half width at half maximum. The energy scale of this scattering is consistent with results reported earlier by both neutron scattering at $q \geqq 1$ A/sup -1/ and Raman scattering at q = 0 (where q, is the momentum transfer) suggesting that the spin-fluctuation relaxation is q-independent.

15025 **Measurement of soft x-ray multilayer mirror reflectance at normal incidence using laser-produced plasmas.** Trail, J.A.; Byer, R.L.; Barbee T.W. Jr. (Department of Applied Physics, Stanford University, Stanford, California 94305). *Applied Physics Letters;* 52: No. 4, 269-271(25 Jan 1988).

We have used laser-produced plasmas as a broadband source of soft x rays to measure the normal incidence reflectance of multilayer mirrors in the 10—25 nm spectral region. The measurements have a spectral resolution of 0.03 nm and a reflectance resolution of 10%. Measurements made on a Mo/Si multilayer show excellent agreement with results obtained using a synchrotron and indicate a normal incidence peak reflectance of over 50% at 15 nm. By repeating the reflectance measurement at different positions across a single 7.5 cm mirror we determined multilayer uniformity as a function of position and we relate this dependence to the geometry of the deposition process.

15026 **Relaxation-time enhancement in the heavy-fermion system $CePd_3$.** Beyermann, W.P.; Gruener, G.; Dalichaouch, Y.; Maple, M.B. (Department of Physics and Solid State Science Center, University of California, Los Angeles, California 90024). *Physical Review Letters;* 60: No. 3, 216-219(18 Jan 1988).

Frequency-dependent conductivity measurements are reported in the dc to 150-GHz range in the moderately heavy-fermion compound $CePd_3$. A Drude expression is found with a renormalized relaxation time tau/sup */, and a renormalized plasma frequency ω/sub p//sup */ at low temperatures. This experiment represents the first direct measurement of these quantities, and the enhanced mass obtained from the frequency-dependent conductivity compares favorably with that determined from thermodynamic measurements.

15027 **Atomistic analysis of the enhanced-modulus effect in metallic superlattices.** Dodson, B.W. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 2, 727-730(15 Jan 1988).

Experimental reports of large enhancements (severalfold) in certain elastic moduli of compositionally modulated transition-metal—noble-metal superlattices have appeared over the last decade. Two general classes of explanations have been proposed for this effect; one depends upon changes in the electronic structure resulting from the superlattice periodicity, whereas the other is based on nonlinear elastic effects driven by the coherency strain of the strained-layer superlattice structures. An atomistic analysis of the elastic properties of a Cu/Ni superlattice has been carried out to differentiate between these ideas. In the case of Cu/Ni superlattices with (100) interfaces and two, four, or six monolayers in each layer, we find roughly a 15% enhancement in the biaxial stretching modulus, compared to the reported severalfold enhancement. The observed enhancement is therefore not due to nonlinear elastic effects driven by coherency strain or interfacial energetics, but probably results from electronic effects associated with the superlattice periodicity.

15028 **Problems with the determination of elastic constants from higher-order surface waves: Results for Al on NaCl.** Nizzoli, F.; Bhadra, R.; de Lima, O.F.; Brodsky, M.B.; Grimsditch, M. (Dipartimento di Matematica e Fisica, Universita-grave-accent degli Studi di Camerino, I-62032 Camerino, Italy). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 2, 1007-1010(15 Jan 1988).

Using Brillouin scattering we have studied the surfacelike generalized Lamb modes in Al films on NaCl. Using a theory in which the elastic constants (C/sub i//sub j/) of Al are taken from bulk values, reasonably good agreement is found for the positions of the peaks. However, we were unable to fit our experimental results to obtain the C/sub i//sub j/ independently, since different combinations of the C/sub i//sub j/ lead to similar spectra and dispersion curves. The changes in the spectra brought about by varying each one of the C/sub i//sub j/ are investigated theoretically, but in no case could the experimental linewidths be reproduced. The fact that the experimental linewidths are much narrower than the calculated ones is very hard to explain unless it is assumed that the Al films are not completely bonded to the substrate. Calculations on unsupported films support this explanation. Our results clearly show the difficulty in obtaining information on elastic constants from an analysis of generalized Lamb modes of a film on a substrate and illustrate some of the problems which can be encountered.

15029 **Fully relativistic Korringa-Kohn-Rostoker coherent-potential-approximation embedded-cluster-method evaluation of short-range-order effects in substitutional alloys containing heavy elements.** Weinberger, P.; Dirl, R.; Boring, A.M.; Gonis, A.; Freeman, A.J. (Institute for Technical Electrochemistry, Technical University of Vienna, Austria). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 3, 1383-1386(15 Jan 1988).

We report calculations of densities of states associated with specific local atomic configurations in substitutionally disordered transition-metal—noble-metal alloys, in particular Au-Pd alloys. These calculations are based on the fully relativistic version of the Korringa-Kohn-Rostoker coherent-potential approximation and on the recently developed corresponding embedded-cluster method, and allow a direct evaluation of short-range-order effects in substitutionally disordered materials. A discussion of our results and a comparison with results obtained for transition-metal alloys such as Pd-Ag is given.

15030 **First-principles study of the pressure-induced bcc-hcp transition in Ba.** Chen, Y.; Ho, K.M.; Harmon, B.N. (Ames LaboratoryU.S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 1, 283-288(1 Jan 1988). Contract W-7405-ENG-82.

The pressure-induced bcc-hcp phase transition in barium has been studied with use of first-principles total-energy calculations. The volume dependence of the complete energy surface from the bcc to the hcp structure has been determined as a function of the atomic displacements corresponding in the bcc phase to the T_1 N-point phonon mode and a long-wavelength shear. The results predict that the frequency of this T_1 N-point phonon mode decreases with increasing pressure, however, before the mode goes soft, the hcp phase becomes the lowest-energy structure and the transition is first order.

15031 **Strain distribution in thin aluminum films using x-ray depth profiling.** Doerner, M.F.; Brennan, S. (IBM General Products Division San Jose, California 95193 and Department of Materials Science and Engineering, Stanford University, Stanford, California 94305). *Journal of Applied Physics;* 63: No. 1, 126-131(1 Jan 1988).

Thin polycrystalline Al films deposited on oxidized Si(100) substrates havebeen studied using grazing incidence x-ray scattering techniques. The films become strained after high-temperature annealing due to the differential thermal expansion of the substrate and film. By varying the grazing angle of incidence on the surface, the penetration depth of the incident x rays can be varied from a minimum of roughly 30 A to a maximum which is deeper than the film thickness. By measuring the change in the Al in-plane peak position with penetration depth, the strain distribution within the film can be determined. For thin films (less than 3000 A) the strain is uniform throughout much of the film, decreasing only very near the surface. Strain relaxation with time occurs uniformly throughout the film over the first 4000 min.

15032 **Low-temperature ion-beam mixing in metals.** Kim, S.; Nicolet, M.; Averback, R.S.; Peak, D. (California Institute of Technology, Pasadena, California 91125). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 1, 38-49(1 Jan 1988).

A systematic study of ion-beam mixing of tracer impurities in thin metal films at low temperatures has been conducted. We have investigated the dependence of ion mixing on two matrix properties: atomic mass and cohesive energy. We have also studied the dependence of ion mixing on tracer impurity properties: its heat of mixing with the matrix and its thermal diffusivity in the matrix. The matrices investigated were thin films of C, Al, Ti, Fe, Ni, Cu,

Mo, Ru, Ag, Hf, Ta, W, Pt and Au. The tracer impurities, Al, Ti, Cr, Mn, Fe, Ni, Cu, Y, Nb, Mo, Ru, Ag, In, Sb, Hf, Ta, W, Pt, Au, and Bi, were deposited as ≲15 A layers near the midplanes of the specimens. All the tracer and matrix elements, except C, were deposited sequentially, without breaking vacuum. The samples were irradiated with 300—1000-keV Kr ions to doses 10/sup 15/—10/sup 16/ ions/cm^2 at temperatures of 6 and/or 77 K. Most samples were analyzed at the irradiation temperature by He backscattering. A strong correlation between ion mixing and the matrix properties, atomic mass, and cohesive energy, was observed. A correlation between ion mixing and tracer impurity diffusion was also observed but not between ion mixing and the heat of mixing or relative mass of the impurity with the matrix. The results are interpreted within the framework of a thermal spike model of cascade diffusion.

15033 **X-ray-absorption fine-structure study of the A15 superconductors $Nb_3(Sn,Sb)$.** Boyce, J.B.; Bridges, F.; Claeson, T.; Geballe, T.H.; Hull, G.W.; Kitamura, N.; Weiss, F. (Xerox Corporation, Palo Alto Research Center, Palo Alto, California 94304). *Physical Review [Section] B: Condensed Matter;* **37**: No. 1, 54-59(1 Jan 1988).

X-ray-absorption fine-structure measurements at the Sn and Sb K edges were made on Nb_3Sn, Nb_3Sb, and Nb_3Sn/sub 1-//sub x/Sb/sub x/ alloys. No temperature-dependent anomalies were noted for the Sn-Nb and Sb-Nb distances or for the broadening in these distances for temperatures from 4.2 K to well above the transition temperatures. The temperature dependence of the broadenings fits an Einstein oscillator model well, with Einstein temperatures of 237 K for Nb_3Sn and 254 K for Nb_3Sb. These results also agree with recent theoretical calculations. The Debye-Waller—type broadening in the Sn-Nb and Sb-Nb distances for the alloys are not equal to one another, but instead are nearly equal to those of the binary end-point compounds, i.e., to Nb_3Sn and Nb_3Sb, respectively.

15034 **Magnetic field dependence of the spin dynamics in the reentrant spin glass Fe/sub 70.4/Al/sub 29.6/.** Boeni, P.; Shapiro, S.M.; Motoya, K. (Brookhaven National Laboratory, Upton, New York 11973-5000). *Physical Review [Section] B: Condensed Matter;* **37**: No. 1, 243-249(1 Jan 1988).

The field dependence of the inelastic neutron scattering from the reentrant spin glass (RSG) Fe/sub 70.4/Al/sub 29.6/ is investigated below T/sub C/. In the intermediate paramagnetic phase 100 K<T<T/sub c//sup inv/ ≃200 K spin waves are induced in an applied field. The peaks broaden rapidly with increasing q and decreasing temperature. Remarkably these excitations exhibit a dispersion curve with a "negative" slope. In a field of 10 kOe the energy gap corresponds to a Zeeman splitting gμ/sub B/H≃0.11 meV. In the spin-glass phase at 10 K no inelastic scattering is observed in a field, although the sample is close to saturation. The results are interpreted in terms of a field-induced dispersion, which has been observed recently in a diluted random antiferromagnet.

15035 **Paramagnetic form factors for cubic itinerant electron systems.** Cooke, J.F.; Liu, S.H.; Liu, A.J. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6032). *Physical Review [Section] B: Condensed Matter;* **37**: No. 1, 289-295(1 Jan 1988).

Measurements of the elastic neutron scattering cross section performed over the past several decades have provided information about the induced magnetic form factor for a number of transition-metal paramagnets. These results, when converted to an absolute scale, provide a sensitive test of electronic wave functions obtained from band calculations. Numerical techniques have been developed to evaluate the static susceptibility on an absolute scale for itinerant electron systems. Results based on local density bands have been obtained for the cubic symmetry paramagnets Cr, Nb, V, Pd, and Rh and compared with experiment. Agreement ranges from excellent for Cr to reasonable for Nb.

15036 **Highly efficient algorithm for percolative transport studies in two dimensions.** Frank, D.J.; Lobb, C.J. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). *Physical Review [Section] B: Condensed Matter;* **37**: No. 1, 302-307(1 Jan 1988).

We present a fast algorithm using the Y-del transformation for calculating the conductance of large two-dimensional random resistor lattices. The procedure can also be used to calculate other quantities for which Y-del transformations can be defined. As an example of the method's usefulness, we present extensive data on square random resistor lattices as large as 1000 bonds on a side. Using this data, we estimate that the conductivity exponent t = 1.303/sub -0.014//sup +0.004/ in two dimensions.

15037 **High-resolution x-ray-scattering study of charge-density-wave modulation in chromium.** Gibbs, D.; Mohanty, K.M.; Bohr, J. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **37**: No. 1, 562-564(1 Jan 1988).

We present a high-resolution x-ray-scattering study of the charge-density-wave modulation in chromium. The wave vector at 2Q was found to vary continuously between 170 and 10 K, consistent with the results of earlier neutron-diffraction studies of the magnetic wave vector at Q. Lock-in transitions, such as have been observed in rare-earth magnets, are apparently not present in chromium.

15038 **Reactions between palladium and gallium arsenide: Bulk versus thin-film studies.** Lin, J.; Hsieh, K.; Schulz, K.J.; Chang, Y.A. (Department of Metallurgical and Mineral Engineering, University of Wisconsin, 1509 University Avenue, Madison, Wisconsin 53706). *Journal of Materials Research;* **3**: No. 1, 148-163(Jan 1988).

Reactions between Pd and GaAs have been studied using bulk-diffusion couples of Pd (~0.6 mm thick)/GaAs and thin-film Pd (50 and 160 nm)/GaAs samples. The sequence of phase formation at 600 °C between bulk Pd and GaAs was established. Initial formation of the solution phase μ and the ternary phase T does not represent the stable configuration. The stable configuration is GaAs chemical bondechemical bondλchemical bondγchemical bondνchemical bondPd and is termed the diffusion path between GaAs and Pd. The sequence of phase formation for the bulk-diffusion couples is similar at 500 °C. Phase formation for the thin-film Pd/GaAs specimens was studied at 180, 220, 250, 300, 350, 400, 450, 600, and 1000 °C for various annealing times. The sequence of phase formation obtained from the thin-film experiments is rationalized readily from the known ternary phase equilibria of Ga—Pd—As and the results from the bulk-diffusion couples of Pd/GaAs. The thin-film results reported in the literature are likewise rationalized. The diffusion path concept provides a useful guide in understanding the phase formation in Pd—GaAs interface or any other M—GaAs interface. This information is important in designing a uniform, stable contact for the metallization of GaAs.

15039 **Molybdenum effect on Fe—Cr—Ni-alloy elastic constants.** Ledbetter, H.M.; Kim, S.A. (Fracture and Deformation Division, Institute for Materials Science and Engineering, National Bureau of Standards, Boulder, Colorado 80303). *Journal of Materials Research;* **3**: No. 1, 40-44(Jan 1988).

This study involved the measurement of the polycrystalline elastic constants of six face-centered-cubic Fe—Cr—Ni alloys, nominally Fe—19Cr—12Ni (at. %). In these alloys, Mo content ranged up to 2.4 at. %. Molybdenum lowers the Young and shear moduli, and it raises the Poisson ratio. Against expectation (because it increases volume), Mo raises the bulk modulus. Qualitatively, the results show that Ni raises the bulk modulus and Poisson ratio; but Ni lowers the Young and shear moduli. (Nickel decreases the alloy's atomic volume.) The discussion includes existing models based on 3d-electron theory.

15040 **Tracer diffusion of ^{60}Co and ^{63}Ni in amorphous NiZr alloy.** Hoshino, K.; Averback, R.S.; Hahn, H.; Rothman, S.J. (Department of Materials Science and Engineering and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Illinois 61801). *Journal of Materials Research;* **3**: No. 1, 55-58(Jan 1988). Contract W-31-109-ENG-38.

Tracer diffusion of ^{60}Co and ^{63}Ni in the amorphous alloy NiZr near the equiatomic composition has been measured in the temperature range between 486 and 641 K using the ion-beam sputter-sectioning technique for serial sectioning. The temperature de-

pendence for the diffusivities of Co and Ni in a-NiZr exhibit Arrhenius behavior; these can be expressed as follows: D/sup */sub Co/ = 3.6 x 10^{-7} exp[-(135 +- 14) kJ mol^{-1}/RT] m^2/s and D/sup */sub Ni/ = 1.7 x 10^{-7} exp[-(140 +- 9) kJ mol^{-1}/RT] m^2/s. The values of D/sup */sub Ni/ are in good agreement with those measured by the Rutherford backscattering technique. The measured diffusivities were independent of time, indicating that no relaxation took place during diffusion.

15041 **Solid-state amorphization of Zr_3Al: Evidence of an elastic instability and first-order phase transformation.** Rehn, L.E.; Okamoto, P.R.; Pearson, J.; Bhadra, R.; Grimsditch, M. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* 59: No. 26, 2987-2990(28 Dec 1987). Contract W-31-109-ENG-38.

Changes in shear elastic constant, long-range order, and lattice parameter were measured during disordering and eventual amorphization of Zr_3Al by ion irradiation. Large (≃50%) elastic softening was observed during disordering, and anomalies occurred in all three measured parameters over a narrow range of ion doses. The results indicate that a first-order phase transformation triggered by an elastic instability occurs during solid-state amorphization. The changes reported here during disordering and amorphization are very similar to behavior observed previously in a large number of solids during heating to melting.

15042 **Role of lattice matching in epitaxy: Novel Ce phase and new fcc-bcc epitaxial relationship.** Homma, H.; Yang, K.; Schuller, I.K. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* 36: No. 18, 9435-9438(15 Dec 1987). Contract W-31-109-ENG-38.

We have grown a novel epitaxial phase of cerium on vanadium using molecular-beam epitaxy and characterized by high-energy electron and x-ray diffraction. The results show that the Ce phase is contracted about 8% in the basal plane and expanded 2% out of the plane when compared to the ambient-temperature and ambient-pressure fcc, γ-Ce. Furthermore, the relative orientation of the Ce(111) and the V(110) planes is different from the well-known epitaxial relationships found to date experimentally and theoretically. The present results imply that electronic structure beyond simple geometrical lattice-matching considerations is important for epitaxial growth.

15043 **Theoretical paramagnetic form factors for hcp transition metals.** Liu, S.H.; Liu, A.J.; Cooke, J.F. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6032). *Physical Review [Section] B: Condensed Matter;* 36: No. 18, 9521-9527(15 Dec 1987). Contract AC05-84OR21400.

The paramagnetic form factor of a metal gives detailed information about the response of the metal to an external static magnetic field. Measurements of this quantity by elastic neutron scattering have been carried out for many paramagnetic transition metals in the past decades. Theoretical understanding of these results has been slow to develop because the orbital contribution of the band electrons to the magnetic moment is difficult to calculate. Recently, we have performed a series of rather accurate form-factor calculations for cubic transition metals and in this paper the same considerations are extended to hexagonal-closed-packed systems. Results based on local-density bands have been obtained for Sc, Lu, Zr, and Y, and there is reasonable overall agreement between theory and experiments.

15044 **Spin correlations in Au/sub 0.85/Fe/sub 0.15/.** Cable, J.W.; Parette, G.; Tsunoda, Y. (Oak Ridge National Laboratory, Solid State Division, P. O. Box X, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* 36: No. 16, 8467-8470(1 Dec 1987). Contract AC05-84OR21400.

Neutron diffuse scattering measurements were used to study the spin correlations in Au—15 at. % Fe. Single-crystal data were obtained in the first Brillouin zone for a [001] orientation at temperatures of 10 and 295 K. The results indicate free spins at 295 K with the development of spin correlations below about 200 K. The cross section at 10 K is similar to that observed by x rays with diffuse streaks in <210> directions and diffuse peaks both at (000) and {11/20}. Intercomparison of the x-ray and neutron data suggests the presence of atomic short-range order consisting of Fe platelets in {420} planes, but with some spatial correlation between the platelets. The magnetic short-range order can be described by ferromagnetic spin correlations in these partially correlated platelets, but with a magnetic correlation length larger than that of the atomic order.

15045 **Neutron scattering measurements of spin fluctuations in the heavy-fermion system UPt_3.** Goldman, A.I.; Shirane, G.; Aeppli, G.; Bucher, E.; Hufnagl, J. (Brookhaven National Laboratory, Upton, New York 11793). *Physical Review [Section] B: Condensed Matter;* 36: No. 16, 8523-8529(1 Dec 1987). Contract AC02-76CH00016.

We report the results of both polarized and unpolarized neutron scattering measurements on single-crystal specimens of the heavy-fermion system UPt_3. At low temperatures ($T<30$ K), and for the energy scales probed in these measurements (h-dashbarω≃6—8 meV), there is antiferromagnetic short-range order between nearest-neighbor uranium-ion moments located in adjacent basal planes. Such order implies that next-nearest neighbors, located within the same basal plane, are correlated ferromagnetically. As the temperature is raised above 18 K, where the bulk in-plane susceptibility has a maximum, the antiferromagnetic correlations between nearest neighbors disappear. However, the ferromagnetic correlations in the basal plane do not vanish until Tapprox. >150 K.

15046 **Magnetic form factor and spin-density asphericity of Ni-Cu.** Cable, J.W. (Oak Ridge National Laboratory, Solid State Division, P.O. Box X, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* 36: No. 16, 8837-8840(1 Dec 1987).

Magnetic form-factor measurements were made on single crystals of a Ni-Cu alloy containing 47.6 at. % Cu. The results give a magnetic moment of 0.088 μ_B/atom at T = 4.2 K and H = 40 kOe in excellent agreement with bulk magnetization data. Despite this order of magnitude decrease in moment relative to Ni, the form factor is the same in both the radial distribution and the asphericity as that previously observed for pure Ni. This result is in strong contrast with an early coherent potential approximation calculation which yields a continuous variation of γ, the fractional E/sub g/ population, with Cu content. It is suggested that some of this discrepancy may be attributed to the neglect of local environment effects, which are known to be important for the magnetism of Ni-Cu alloys.

15047 **Mechanical behavior of aluminum-lithium alloys at cryogenic temperatures.** Glazer, J.; Verzasconi, S.L.; Sawtell, R.R.; Morris, J.W. Jr. (Lawrence Berkeley Lab., Berkeley, CA 94720). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* 18A: No. 10, 1695-1702(Oct 1987). Contract AC03-76SF00098.

The cryogenic mechanical properties of aluminum-lithium alloys are of interest because these alloys are attractive candidate materials for cryogenic tankage. Previous work indicates that the strength-toughness relationship for alloy 2090-T81 (Al-2.7Cu-2.2Li-0.12Zr by weight) improves significantly as temperature decreases. The subject of this investigation is the mechanism of this improvement. Deformation behavior was studied since the fracture morphology did not change with temperature. Tensile failures in 2090-T81 and -T4 occur at plastic instability. In contrast, in the binary aluminum-lithium alloy studied here they occur well before plastic instability. For all three materials, the strain hardening rate in the longitudinal direction increases as temperature decreases. This increase is associated with an improvement in tensile elongation at low temperatures. In alloy 2090-T4, these results correlate with a decrease in planar slip at low temperatures. The improved toughness at low temperatures is believed to be due to increased stable deformation prior to fracture.

15048 **Cryogenic properties of a P/M Ni/sub 3/Al-B alloy.** Chang, K.M.; Huang, S.C.; Taub, A.I.; Chang, G.M.; Morris, J.W. Jr. (Materials Lab., General Electric Co., Corp. Research and Development, Schenectady, NY 12301). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 10, 1819(Oct 1987).

Polycrystalline Ni/sub 3/Al-based intermetallic alloys have overcome their room temperature brittleness problem with a small amount or boron addition. Because of their unique strength-temperature relationship and good oxidation resistance at high temperatures, research efforts have been concentrated extensively on structural applications at elevated temperatures. In this paper the authors show that ductile Ni/sub 3/Al-B alloys also exhibit remarkable mechanical properties at cryogenic temperatures.

15049 **Laser-induced etching.** Ashby, C.I.H. (Sandia National Laboratories, Laser and Atomic Physics Division, Albuquerque, New Mexico 87185). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 586-593(25 Sep 1987). (CONF-861038—). Contract AC04-76DP00789.

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

Laser-induced etching of metals, semiconductors, and other inorganic materials can be etched by ablation, localized heating to enhance a thermally activated chemical reaction, or photogeneration of a good etchant from a less reactive precursor. In addition, semiconductors can be etched following photoexcitation of the surface to produce free carrierrs. The advantages and disadvantages of these four approaches to laser-induced etching are reviewed in this paper.

15050 **Silver clusters as the active sites for surface enhanced Raman scattering.** Furtak, T.E.; Roy, D. (Colorado School of Mines, Golden, Colorado 80401). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 452-454(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

We propose that the active sites for resonant Raman scattering on Ag are small positively charged Ag clusters. These are stabilized by the "special" surface treatments that have been shown to produce the largest efficiencies for surface enhanced Raman scattering (SERS). We present a summary of our arguments which are based on low energy data and a dynamical calculation for vibrational energies of the clusters.

15051 **Development of rike techniques using picosecond lasers.** Schauer, M.W.; Pellin, M.J.; Biwer, B.M.; Gruen, D.M. (Argonne National Laboratory, Argonne, IL 60439). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 417-419(25 Sep 1987). (CONF-861038—). Contract W-31-109-ENG-38.

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

The sensitivity of the Raman-induced Kerr effect is greatly enhanced through the use of picosecond lasers. Experiments in dilute solutions of benzene indicate that sensitivity at the monolayer level is achievable. Applications to transparent media, to fluorescing samples, and to in situ measurements of electrode surfaces are discussed.

15052 **(ESA-TT—1023) Crack initiation and propagation due to cyclic thermal gradients.** Lesne, P.M. (European Space Agency, 75 - Paris (France)). Sep 1987. Transl. into ENGLISH of Amorcage et Propagation de Fissures sous Gradients Thermiques Cycliques (Chatillon, France). (ONERA-P—1985-2; ETN—87-91112). 182p. NTIS, PC A09/MF A01.

Tests were made on a simple thin plate of IN100 superalloy approximating the shape of a turbine blade, in which crack initiation and propagation by thermal fatigue were produced, to develop a method for predicting the creep-fatigue lifetime of such structures under variable temperature conditions. A finite element method including cyclic viscoplastic constitutive equations was used to calculate the stresses and plastic strains at every point on the blade at successive cycles, using the temperature distribution maps and variable-temperature constitutive equations as given data. The crack initiation can be calculated from the variable-temperature fatigue damage and creep laws, using the hysteresis loop at the stabilized (12th) cycle. Crack propagation, carefully measured during the tests, is predicted by a method based on linear fracture mechanics, taking the viscoplastic behavior of the material into account. The calculation/test comparison is good for initiation and propagation.

15053 **Effect of growth rate dependent partition coefficient on the dendritic growth in undercooled melts.** Trivedi, R.; Lipton, J.; Kurz, W. (Ames Lab.-USDOE and Dept. of Materials Science and Engineering, Iowa State Univ., Ames, IA 50011). *Acta Metallurgica;* **35**: No. 4, 965-970(Apr 1987).

The theory of alloy dendritic growth at large undercoolings is extended to include the effect of growth rate dependent partition coefficient on the growth rate, tip radius and composition of dendrites. Three distinct behaviors are observed depending on the value of the dimensionless rate upsilon. For small values of upsilon,k ≃ k/sub 0/. For the intermediate range, when upsilon is between 0.01 and 100, a significant effect of the velocity dependent partition coefficient is found. When upsilon $>$ 100, $k \rightarrow 1$ and the dendrite behavior in an alloy is found to approach that for the pure material. In undercooled alloy melts segregation free zones could then be obtained by dendrite growth.

15054 **Rapid dendrite growth in undercooled alloys.** Lipton, J.; Kurz, W.; Trivedi, R. (Dr. Muller Feindraht AG, 8800 Thalwil-Zurich). *Acta Metallurgica;* **35**: No. 4, 957-964(Apr 1987).

The theory of dendritic growth into undercooled alloy melts is extended to the case of large undercoolings, i.e. to high growth rates. This is done by applying the results of the complete stability analysis of a plane interface to the tip of an Ivantsov dendrite. For small Peclet numbers this model corresponds to a model published previously. For large Peclet numbers i.e. large undercoolings, however, the stability parameters become functions of Peclet numbers and cause drastic changes in the growth behaviour of the dendrite. Furthermore the limit of absolute stability is predicted when the undercooling is equal to the sum of the thermal unit undercooling and the equilibrium freezing range of the alloy.

15055 **Point defect-dislocation interactions in copper following pulsed neutron and electron irradiations.** Parkin, D.M.; Goldstone, J.A.; Simpson, H.M.; Hemsky, J.M. (Los Alamos National Lab., NM, USA; North Carolina Univ., Charlotte, US. Dept. of Physics; Wright State Univ., Dayton, US. Dept. of Physics). *Journal of Physics F (London). Metal Physics (London);* **17**: No. 3, 577-592(Mar 1987).

Two aspects of point defect-dislocation interactions, peaking effect and kinetics, following pulsed electron and neutron irradiations have been studied in high-purity polycrystalline copper. In all experiments, an initial very rapid rise in the internal friction and Young's modulus was observed, followed by a slower continuous change. The rise of the internal friction shows the presence of the peaking effect. The magnitude of the rapid change in the modulus was proportional to the fluence. The initial rise was too fast for detailed kinetics analysis; however, the slower process was analysed. Results are interpreted in terms of a model wherein interstitials are rapidly deleted from the lattice and responsible for the initial rise, while the slower process is due to vacancy diffusion to dislocations. These data also show that interstitials are responsible for the peaking effect. Models proposed to explain the peaking effect are discussed in the light of these results.

15056 **Hot-cracking mechanism in CO/sub 2/ laser beam welds of dissimilar metals involving PH martensitic stainless steels.** Cieslak, M.J. (Process Metallurgy Div., Sandia National Labs., Albuquerque, NM). *Welding Journal (Miami);* **66**: No. 2, 57-S(Feb 1987). Contract AC04-76DP00789.

Autogenous CO/sub 2/ laser beam welds were made between Alloy HP 9-4-20 and both 15-5 PH and PH 13-8 Mo stainless steel. Small scale circular-patch test specimens revealed that the

combination involving the Nb-bearing alloy, 15-5 PH, was far more crack susceptible than the combination involving the Nb-free alloy, PH 13-8 Mo. Analytical electron microscopy was used to identify an NbC/austenite eutectic-like constituent as being responsible for the cracking phenomenon.

15057 **Physics and chemistry of small clusters.** Jena, P.; Rao, B.K.; Khanna, S.N. (eds.). New York, NY; Plenum Press (1987). 934p. (CONF-8610159—). Plenum Press Publishing Corp., 233 Spring St., New York, NY 10013. Order Number TI88004091/JAW. Contract FG05-86ER45235.

From International symposium on the physics and chemistry of small clusters; Richmond, VA, USA (28 Oct 1986).

This book contains papers on physical and chemical phenomena of solid clusters. The papers cover the atomic and electronic structure, dynamics, stability, fragmentation, optical properties, interaction with adsorbates, astrochemistry and van der Waals forces of clusters. (LSP)

15058 **Temperature dependence of erosion - some correlations for Ti-6Al-4V.** *Materials and Components in Fossil Energy Applications;* No. 65, 4-6(1 Dec 1986).

The understanding of the erosion behavior of metals and alloys at high temperatures is complicated by the numerous factors involved, and as yet no basis has been established for predicting alloy performance. The study described here was an attempt to develop a model relating erosion rate to micromechanical properties and, through the temperature dependence of these properties, to temperature. The model was supported by experimental data obtained for a Ti-6Al-4V alloy. The mathematical model developed from consideration of the microstructure resulting from plastic deformation processes - and the relationships between strength, ductility, and microhardness measurements - states essentially that the erosion rate should vary inversely with the product of the tensile strength and the uniform elongation. Results on hardness, ductility, and erosion are given and discussed. 2 references, 4 figures.

15059 **Hydrogen trapping in niobium-vanadium alloys.** Pick, M.A.; Shapiro, S.M.; Stoneham, A.M. (Brookhaven National Lab., Upton, NY, USA; UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). *Journal of Physics F (London). Metal Physics (London);* 16: No. 8, 961-968(Aug 1986). Contract AC02-76CH00016.

The localised vibrational modes of hydrogen in a Nbsub(0.93) Vsub(0.07) alloy have been measured. As one cools the sample for the first time to 10 K one observes that hydrogen is trapped at octahedral sites associated with two substitutional vanadium atoms. The trap energy is small (10-20 meV) and less than the precipitation enthalpy. The phenomenon exhibits an interesting hysteresis. On repeated cooling cycles the hydrogen atoms tend to precipitate rather than stay in the trap sites. This is due to the formation of additional nucleation sites on the first cooling cycle.

15060 **Theories of heavy-electron systems.** Lee, P.A.; Rice, T.M.; Serene, J.W.; Sham, L.J.; Wilkins, J.W. (Los Alamos National Lab., NM, USA). *Comments on Condensed Matter Physics;* 12: No. 3, 99-161(Mar 1986).

The paper reviews theoretical attempts to understand heavy-electron systems. Single-impurity results, intersite interactions in heavy electrons, band structures, fluctuations and the 1/Nsub(f) expansion, fermi liquid theory, and heavy-electron superconductivity, are all discussed.

15061 **Evaluation of the transgranular cracking phenomenon on the Indian Point No. 3 steam generator vessels.** Czajkowski, C.J. (Brookhaven National Lab., Upton, NY, USA). *International Journal of Pressure Vessels and Piping;* 26: No. 2, 97-110(1986).

A metallurgical investigation was performed on specimens from the shell of steam generators Nos 31 and 32 of the Indian Point-3 power plant. The shell material exhibited high values in hardness which was indicative that relatively high residual stresses may have been present. All observed cracks were transgranular in appearance and were associated with pits on the vessels' inside surfaces. Both stress relieved and non-stress relieved specimens of SA302 Grade B material were tested in a constant extension rate apparatus in various environments in order to reproduce the transgranular cracking at Indian Point-3. The paper concludes that SA302 Grade B material is susceptible to transgranular stress corrosion cracking (SCC) in constant extension rate testing (CERT) with as little as 1 ppm chloride (as $CuCl_2$) in H_2O at 268°C.

15062 **Preparation of actinide-metal research.** Aaron, W.S.; Culpepper, C.A.; Campbell, K.B. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* 52: 348(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The preparation of actinide-metal research materials is one of many functions of the Isotope Research Materials Laboratory (IRML) at Oak Ridge National Lab. Research samples of uranium, plutonium, americium, and curium, typically from milligram quantities up to ~ 100 g, are prepared as pure metals or alloys to customer specifications. Larger quantities, up to many kilograms, of the lower activity actinides, such as ^{235}U, ^{238}U, and ^{232}Th, are also fabricated into custom research forms. Physical forms of these metals include rolled foils or sheets, castings (ingot, rod, or special shapes), and evaporated or sputtered films.

15063 **Precision cutting and drilling with the Nd-YAG laser.** Lingenfelter, A.C.; Anglin, C.D.; Westrich, C.N.; Murchie, J.R. (Lawrence Livermore National Lab.). pp vp of The fifth international congress on applications of lasers and electrooptics (Technical Digest). Toledo, OH; Laser Institute of America (1986). (CONF-861197—). Contract W-7405-ENG-48.

From ICALEO '86: laser application conference; Arlington, VA, USA (10 Nov 1986).

The Laser Processing Facility of the Materials Fabrication Division of Lawrence Livermore National Laboratory has two pulsed Nd-YAG lasers mounted on machine tool bases. Over the years the authors have had requirements for cutting a wide variety of materials, frequently to very tight dimensional tolerances. They have found that the laser process is particularly well suited for two application areas; (1) for thin cross sections of most all materials, and (2) for refractory metals and ceramics such as tungsten, tantalum, and molybdenum, silicon wafers, alumina, and graphite foil. Some of these materials are difficult if not impossible to cut and drill in any other manner. Examples of each of these types of applications are sighted. Data are presented to illustrate the effects and interactions of laser parameter variables such as aperturing, choice of lenses, focus, pulse length, and energy level. Examples of applications are shown.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 14155, 14548, 14791, 14928, 14996, 14997, 14998, 14999, 15000, 15005, 15063, 15164, 15487, 15491, 15514, 15545

15064 **(AERE-M—3574) Radiation enhanced conduction in insulators: computer modelling.** Fisher, A.J. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Oct 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750923/JAW.

The report describes the implementation of the Klaffky-Rose-Goland-Dienes [Phys. Rev. B.21 3610,1980] model of radiation-enhanced conduction and describes the codes used. The approach is demonstrated for the data for alumina of Pells, Buckley, Hill and Murphy [AERE R.11715, 1985].

15065 **(AERE-M—3588) Electrical impedance studies of uranium oxide.** Hampton, R.N. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Nov 1986. 105p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750933/JAW.

The thesis presents data on the electrical properties of uranium oxide at temperatures from 1700K to 4.2K, and pressures between 25 K bar and 70 K bar. The impedance data were analysed using the technique of complex plane representation to establish the conductivity and dielectric constant of uranium dioxide. The thermophysical data were compared with previously reported experi-

mental and theoretical work on uranium dioxide and other fluorite structured oxides. (U.K.).

15066 **(BNL—40441) The electronic structure of YBa_2Cu_3O/sub 7-δ/ above and below T/sub c/.** Qiu, S.L.; Ruckman, M.W.; Johnson, P.D.; Chen, J.; Jiang, L.; Lin, C.L.; Strongin, M.; Sinkovic, B.; Brookes, N. (Brookhaven National Lab., Upton, NY (USA); Bell Labs., Murray Hill, NJ (USA); Texas Univ., Austin (USA)). 1987. Contract AC02-76CH00016. 17p. (CONF-871178—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003495/JAW.

From Thin film processing and characterization of high temperature superconductors; Anaheim, CA, USA (6 Nov 1987).

The electronic structure of YBa_2Cu_3O/sub 7-δ/ has been investigated using synchrotron radiation above and below the superconducting transition temperature. Valence band spectra show a low density of states at the Fermi level, a shift of the Cu3d-O2p derived bands ~1.5 eV below their calculated binding energy and a Cu 3p-3d shake-up satellite that suggests localization of the copper 3d-states and also suggests that the copper ions have 2+ valence. Core-level spectra also give evidence of the Cu^{2+} ion and show at least two distinct oxygen bonding environments. Cooling the surface to 20K, leaves the Cu and Ba core-levels unmodified, may produce a new O 1s core-level component at 533 eV and causes a small change in the shape of the valence band. The Cu 3p-3d satellite is weaker and increased photoemission coincident with states derived from the O 2p orbitals at the Cu 3p threshold is noted in the valence band. These changes upon cooling suggest that small changes in the Cu-O electronic states occur and their possible relevance to superconductivity is discussed. 22 refs., 4 figs.

15067 **(BNL—40465) Grain boundaries, planar defects and superconducting properties of $YBa_2Cu_3O_7$.** Tafto, J.; Suenaga, M.; Wang, T.; Sabatini, R.L.; Moodenbaugh, A.R.; Levine, S. (Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA). Dept. of Materials Science). Nov 1987. Contract AC02-76CH00016. 4p. (CONF-871124—44). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003477/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Polycrystalline samples of tetragonal YBa_2Cu_3O/sub 6.25/ were transformed into the superconducting orthorhombic phase by annealing in an oxygen atmosphere at temperatures ranging from 400 to 850°C and then slowly cooled to room temperature (15°C/h). Transmission electron microscopy (TEM) images of these samples and samples prepared in the usual way show layers of amorphous or highly disordered material, several 100 nm thick, at a large fraction of the grain boundaries. Also all samples contain 10 to 100 nm thick sheets of disordered material which lie in the a-b planes and tend to run through the entire crystal grain. In the a-b planes we also observe dislocation loops, particularly in the as-quenched tetragonal samples and stacking faults in the heat-treated samples. We also frequently observe set of twins with orthogonal habit planes within a crystal grain. We attribute the low critical current density in $YBa_2Cu_3O_7$ to these planar faults and the disordered grain boundary regions, and discuss the TEM observations with reference to resistivity and inductive measurements. 11 refs., 6 figs.

15068 **(BNL—40466) Orientation dependent x-ray absorption near edge structure in $YBa_2Cu_3O_7$ and La/sub 1.85/ Sr/sub 0.15/CuO_4.** Heald, S.M.; Tranquada, J.M.; Moodenbaugh, A.R.; Xu, Y. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016;AS05-80ER10742. 5p. (CONF-871124—45). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003476/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

X-ray absorption measurements have been made on powder samples of $YBa_2Cu_3O_7$ and La/sub 1.85/Sr/sub 0.15/CuO_4 oriented in a magnetic field. Measurements made at the Cu K edge with x-ray polarization oriented perpendicular parallel to the c-axis show distinct differences for both materials, indicating a strong anisotropy of the electronic states about the Cu atoms. The Y edge measurements show a much smaller anisotropy as expected due to its more symmetric environment. Preliminary analysis indicates these measurements should be useful in choosing between the conflicting interpretations of the near edge structure in these materials. 12 refs., 3 figs.

15069 **(BNL—40480) Superconducting properties and structural characterization of high T/sub c/ oxides.** Moodenbaugh, A.R.; Cox, D.E.; Hurst, J.J.; Asano, T.; Sabatini, R.L.; Suenaga, M. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 5p. (CONF-8706125—25). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003479/JAW.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

A desire to provide good quality oxide superconducting specimens for research requires careful characterization of samples. Earlier, straightforward methods for preparation of La/sub 2-x/Sr/sub x/CuO_4 and $YBa_2Cu_3O_7$ superconductors were described. However, these methods are not completely defined, and samples prepared nominally according to recipe may vary in superconducting properties and with respect to the presence of nonsuperconducting minority phases (primarily observed in x-ray diffraction work). Here we describe methods of preparation for these oxides which we utilized, and of techniques used to evaluate these materials. 7 refs., 3 figs.

15070 **(BNL—40481) Superconductivity and phase stability in the heavy rare earth quaternary compounds $RBa_2Cu_3O_7$ (R = Ho, Er, Tm, Yb, Lu).** Ku, H.C.; Yang, H.D.; McCallum, R.W.; Noack, M.A.; Klavins, P.; Shelton, R.N.; Moodenbaugh, A.R. (Ames Lab., IA (USA); Brookhaven National Lab., Upton, NY (USA)). Apr 1987. Contract AC02-76CH00016;W-7405-ENG-82. 4p. (CONF-870438—38). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003478/JAW.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Phase stabiliy and superconducting properties of heavy rare earth compounds $RBa_2Cu_3O_7$ (R = Ho, Er, Tm, Yb, Lu) were studied and found to be unstable above 950°C. Transition temperatures depend heavily on starting materials, thermal history, oxygen content and the interpretation of the data. Magnetic rare earth ions have little effect on the transition temperature. However, these magnetic compounds should order magnetically, probably in the mK range. 10 refs., 4 figs., 1 tab.

15071 **(BNL—40489) Penetration depth measurements of YBa_2Cu_3O/sub 7-δ/ at 4 MHz.** Wiesmann, H.; Corderman, R.R.; Moodenbaugh, A.R.; Strongin, M. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 4p. (CONF-871124—46). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003493/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Measurements were made of the penetration depth of bulk and powder samples of YBa_2Cu_3O/sub 7-δ/. The samples were placed in an inductor which was part of the resonant circuit of a 4 MHz tunnel diode oscillator. The oscillator was stable to at least 1 part in 10^8 at 77°K. Changes in the sample susceptibility were easily detected by changes in the oscillator frequency. Analysis of the smallest powders fabricated gave a value of the measured penetration depth λ/sub mea/ = 0.23 μm. The measurement methodology is quantitative and the value of λ/sub mea/ is believed to be an upper bound of the true penetration depth. 4 refs., 3 figs.

15072 **(BNL—40538) Single-crystal structural study of La_2Cu/sub 0.95/Li/sub 0.05/O_4.** Delgado, J.M.; McMullan, R.K.; Diaz de Delgado, G.; Speck, J.S.; Wuensch, B.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering; Brookhaven National Lab., Upton, NY (USA); Brandeis Univ., Waltham, MA (USA). Dept. of Chemistry). 1987. Contract AC02-76CH00016. 7p. (CONF-8711114—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003482/JAW.

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

A large crystal of flux-grown La_2CuO_4, examined through single-crystal neutron diffraction, was found to have an orthorhombic superstructure. The pattern of systematically absent intensities indicated space group Pccn but meaningful refinement of thermal vibration parameters could not be obtained in this symmetry. Systematic examination of all possible orthorhombic subgroups of Fmmm yielded satisfactory refinement to $R(F^2) = 2.57\%$ only in space group Bmab. Incorporation in the crystal of Li derived from the flux results in an orthorhombic distortion smaller than found for pure La_2CuO_4. Refinement of the Cu site occupancy provided Cu/sub 0.950/Li/sub 0.050(3)/, in excellent accord with a bulk chemical analysis. Reflections which violate the systematic absences of Bmab are attributed to a smaller volume fraction of domains in orientation twinned by 90° rotation about c. This interpretation is supported by transmission electron microscopy which revealed intergrown lamellae. Dark field imaging with a forbidden reflection illuminated only the twin lamellae. 15 refs., 1 fig., 1 tab.

15073 (BNL—40558) Measurement of the magnetic form factor of Cu in antiferromagnetic La_2CuO_4. Mitsuda, S.; Freltoft, T.; Shirane, G.; Remeika, J.P.; Cooper, A.S. (Brookhaven National Lab., Upton, NY (USA); Tokyo Univ. (Japan). Inst. for Solid State Physics; Bell Labs., Murray Hill, NJ (USA)). 1987. Contract AC02-76CH00016. 5p. (CONF-871124—59). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004861/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The magnetic form factor for Cu in the antiferromagnetic state of a single crystal La_2CuO_4 has been measured using neutron diffraction. Our result is consistent with Freeman and Watson's calculation for Cu^{2+}, at least up to $Q = 4A^{-1}$, although a plateau between 1 and 3 A^{-1} suggests a small contribution of magnetic moment at the out-of-plane oxygen sites. For larger values of Q the form factor for La_2CuO_4 seems to drop faster than for Cu^{2+}. The sample ordered antiferromagnetically at T/sub N/ ≃ 185K with an average ordered moment $\mu = 0.30$ μ/sub B/ per Cu atom.

15074 (BNL—40590) High-resolution x-ray microstructural study of single crystals of YBa_2Cu_3O/sub 7-y/. You, Hoydoo; Axe, J.D.; Kan, X.B.; Moss, S.C.; Liu, J.Z.; Lam, D.J. (Brookhaven National Lab., Upton, NY (USA); Houston Univ., TX (USA). Dept. of Physics; Argonne National Lab., IL (USA)). 1987. Contract AC02-76CH00016;W-31109-ENG-38. 5p. (CONF-871124—56). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004856/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Single crystals of YBa_2Cu_3O/sub 7-y/ were studied by transmission Laue photography and monochromatic diffraction techniques, using the Cornell High Energy Synchrotron Source and a rotating anode x-ray source. A new type of twinning with two orthorhombic domains rotated exactly 90 degree about the c axis, was observed in one sample and the conventional (110) type twinning in another sample with nominally identical growth conditions. A high resolution diffraction study of the sample with the conventional (110) twinning shows that measured orthorhombicity (proportional to oxygen ordering parameter) varies from one domain to another. 10 refs., 4 figs.

15075 (CEA-CONF—8978) Electron structure of defects in AlN films produced by N/sup +/ ion implantation. Gautier, M.; Duraud, J.P.; Le Gressus, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Mar 1987. 6p. (CONF-8703154—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751535/JAW.

From International symposium on trends and new applications in thin films; Strasbourg, France (16 Mar 1987).

Implantation of 10 KeV N/sup +/ ions in high purity aluminium monocrystals allows development of crystal aluminium nitride films, in perfect epitaxy on substrate. The electronic structure of defects created by ion implantation is studied by slow electron energy loss spectroscopy and core level spectroscopy. These defects give to the AlN surface a weak reactivity.

15076 (CEA-CONF—9056) Damage functions generation for polyatomic materials irradiated in test reactors. Alberman, A.; Lesueur, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Jun 1987. 25p. (In French). (CONF-870501—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751544/JAW.

From 6. ASTM-Euratom symposium on reactor dosimetry; Jackson Hole, WY, USA (31 May 1987).

Neutron exposure parameters in polyatomic materials is of great importance for fusion technology programs. The COMPOSI code computes the number of displaced atoms of sub-lattice "j" induced by one atom of sub-lattice "i" either by direct collision or through intermediate knocked atom. The code uses Lindhard equations; it is solved by iterative process. The atomic displacements cross-sections, as a function of neutron energy are derived by folding previous results with "i" type PKA. Moreover the COMPOSI code may include recoils from charged particles e.g.: Alpha + Triton from Li/sup 6/ capture in Li Al 0/sub 2/). These responses in various spectra are discussed.

15077 (CEA-CONF—9138) Low field anisotropic properties of a single crystals of superconducting YBa/sub 2/Cu/sub 3/O/sub 7-δ/. Hammann, J.; Ocio, M.; Vincent, E.; Bertino:ti, A.; Luzet, D.; Revcolevschi, A.; Jegoudez, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). Sep 1987. 11p. (CONF-870881—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751717/JAW.

From 18. conference on superconductivity in highly correlated fermion systems; Sendai, Japan (31 Aug 1987).

Low field ($0.4G \leqq H \leqq 3G$) magnetization measurements have been performed on small single crystals of superconducting YBa/sub 2/Cu/sub 3/O/sub 7.δ/ using a SQUID magnetometer. They revealed anisotropic properties in the temperature dependences of the shielding and the Meissner effects. A sharp unique transition at 95 K is observed with the field parallel to c. In the perpendicular direction a second transition line seems to be crossed at $T^* = 84$ K. This temperature T^* remains constant in the range of fields investigated.

15078 (CEGB-TPRD/B—0798/R86) X-ray photoelectron spectroscopy of the uranium/oxygen system. Part 10. The formation of U_3O_8 on crystalline UO_2. Allen, G.C.; Tempest, P.A.; Tyler, J.W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). May 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750928/JAW.

As part of a wider programme to investigate the low temperature oxidation behaviour of UO_2 in the event of gas ingress to a fuel can during handling or storage, the behaviour of individual grains in bulk UO_2 has been simulated using single crystal surfaces. Bulk oxidation of fuel pellets and the mechanism involved in the formation of U_3O_8 particulate can then be interpreted in terms of oxidation at both grain centres and grain boundaries. To this end the oxidation of the (111) surface of crystalline UO_2 through U_3O_7 to U_3O_8 has been studied by X-ray photoelectron spectroscopy and X-ray diffraction. Oxidation was carried out at 190°C and 300°C in 1 Torr of oxygen. The possible formation of UOsub(2+x) and U_4O_9 was not observed under these conditions. Anisotropic growth of U_3O_8 revealed an epitaxial relationship between the cubic close-paced (111) plane of fluorite UO_2 and the (001) basal plane of orthorhombic U_3O_8. It is proposed that the clustering of oxygen interstitial atoms in the fluorite lattice is instrumental in its ultimate breakdown and becomes the framework for subsequent formation of U_3O_8.

15079 (CONF-8707132—2) Application of x-ray computed tomography to ceramic/ceramic composites. Ellingson, W.A.; Vannier, M.W.; Stinton, D.P. (Argonne National Lab., IL (USA); Oak Ridge National Lab., TN (USA)). Jul 1987. Contract W-31109-ENG-38. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002903/JAW.

From Symposium on characterization of advanced materials; Monterey, CA, USA (27 Jul 1987).

A computed tomographic imaging system has been given an initial evaluation for the ability to detect voids and characterize fiber orientation in ceramic composites consisting of SiC fibers in a matrix of chemical vapor infiltrated SiC. Specimens with various fiber loadings and different final densities, fabricated from random chopped fibers, continuous unidirectional fibers, and layups of various cloth types were examined. Speciments in various early stages of processing were also examined to see if the presence of a graphite fixture (used in the CVI process) caused image degradation. Results show that the CT images are able to discriminate among fabric weaves and show major fabric-weave characteristics prior to SiC impregnation, after impregnation to at least 85% of theoretical density, and in the presence of a graphite holder. However, with the currently available 100-μm pixel size and implementation of zoom features, individual voids on the order of 200 μm cannot be detected. 10 refs., 22 figs., 3 tabs.

15080 (CONF-8711126—1) Optical waveguide formation by ion implantation of Ti or Ag. Poker, D.B.; Thomas, D.K. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004595/JAW.

From Symposium on fundamentals of beam-solid interactions and transient thermal processing; Boston, MA, USA (30 Nov 1987).

Ion implantation of Ti into $LiNbO_3$ has been shown to be an effective means of producing optical waveguides, while maintaining better control over the resulting concentration profile of the dopant than can be achieved by in-diffusion. While undoped, amorphous $LiNbO_3$ can be regrown by solid-phase epitaxy at 400°C with a regrowth velocity of 250 A/min, the higher concentrations of Ti required to form a waveguide (~10%) slow the regrowth considerably, so that temperatures approaching 800°C are used. Complete removal of residual damage requires annealing temperatures of 1000°C, not significantly lower than those used with in-diffusion. Solid phase epitaxy of Ag-implanted $LiNbO_3$, however, occurs at much lower temperatures. The regrowth is completed at 400°C, and annealing of all residual damage occurs at or below 800°C. Furthermore, the regrowth rate is independent of Ag concentration up to the highest dose implanted to date, 1×10^{17} Ag/cm². The usefulness of Ag implantation for the formation of optical waveguides is limited, however, by the higher mobility of Ag at the annealing temperature, compared to Ti. 7 refs., 4 figs.

15081 (CONF-8711136—1) Friction and wear of ion-implanted TiB_2. Yust, C.S.; McHargue, C.J.; Harris, L.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005051/JAW.

From 3. international conference on the science of hard materials; Nassau, Bahamas (8 Nov 1987).

The unlubricated sliding of diamond and tungsten carbide against nickel-ion implanted titanium diboride have been investigated. The diamond sliding is characterized by low friction (<0.02) and the formation of a carbon-bearing debris layer on the wear path. Tungsten carbide slides on TiB_2 with a stick slip motion and friction values ranging from 0.2 to 1.0, and forms wear grooves. The effect of implantation on sliding wear rates have been explored by sequential wear tests which indicate a limitation of the wear groove depth to that of the modified lattice. 14 refs., 8 figs., 2 tabs.

15082 (DOE/ER/45092—T3) The migration of grain boundaries in ceramic materials with particular reference to the sintering process: A progress report for the period covering approximately November 15, 1987-November 14, 1987. Carter, C.B. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Nov 1987. Contract FG02-84ER45092. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004085/JAW.

Purpose is to understand how the structure and chemistry of grain boundaries influence the sintering and densification of polycrystalline ceramic materials. The study has been limited to alumina, spinel and germanium. This choice of materials allows effects associated with a particular type of crystal structure of interatomic bonding may be distinguished from effects which are common to all ceramic materials. The following lines of work have been followed: The analysis of surfaces of alumina has been extended to other materials. The faceting of alumina/glass interfaces has been continued. The first alumina bicrystals have been prepared using the new Centaur (2000°C) hot-press. A method for quantifying grain growth in NiO thin films is being developed. On high-Tc materials, we have been involved in some exploratory work on the grain boundary structures present in thin films. The following topics are now being considered: application of the O-lattice, the coincident-site lattice (CSL) and DSC lattice concepts to ceramic systems; we are continuing our analysis of thin amorphous phases in grain boundaries using HREM image simulation; and the relation between surfaces, grain boundaries, pores and sintering.

15083 (DOE/ER/45097—T3) Defect clustering and related properties of oxides: Annual technical progress report. Cohen, J.B.; Ellis, D.E.; Mason, T.O. (Northwestern Univ., Evanston, IL (USA)). 10 Dec 1987. Contract FG02-84ER45097. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004083/JAW.

Defects, lattice parameters, crystal growth, and electrical properties have been examined in several oxides. The major development in structural refinement has been the ability to properly estimate thermal diffuse scattering. Theoretical studies have continued, with the characterization of defect clusters and vacancies in the 3d transition metal monoxides. In other areas, pseudobinary Ni/sub x/Ca/sub 1-x/O rock salt structure has been studied as a function of composition. Electronic response to doping of cubic zirconia by X^{2+} and Y^{3+} ions to stabilize the oxygen vacancy structure has also been studied, and preliminary studies on the La_2CuO_4, YBa_2Cu_3O/sub 7-x/ have been carried out. (CBS)

15084 (DOE/ER/45150—T1) Analytical electron microscopy studies of interfaces and phase transformations in zirconia ceramic systems: Progress report, July 1, 1987-June 30, 1988. Notis, M.R. (Lehigh Univ., Bethlehem, PA (USA)). 1988. Contract FG02-84ER45150. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005208/JAW.

Goal is to gain an understanding of the nature of interphase interfaces, phase-equilibria and phase transformations in ceramic systems which have high potential for property improvement through transformation toughening. We have focused our attention on studies concerning: (1) the nature of interphase interfaces in zirconia based eutectics, and (2) the effects of ternary additions on the growth kinetics of precipitates in magnesia partially stabilized zirconia (Mg-PSZ) ceramics. We have been able to use our understanding of twinning behavior to explain the nature of twin structure present in ceramic superconductors.

15085 (DOE/ER/45279—T1) Ceramic decomposition under irradiation: Progress report. Howitt, D.G. (California Univ., Davis (USA). Dept. of Mechanical Engineering). 1987. Contract FG03-86ER45279. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004327/JAW.

Our quantitative determinations of the decomposition of thin film and bulk ceramic materials during electron microscopy has shown that the radiation damage effect is a complex one depending upon the dielectric properties. In low-melting-temperature glasses, for example, much of the activity is due to field enhanced diffusion of low atomic weight species. This is particularly true of bulk specimens and for the case of binary soda-borosilicate glass the sodium depletion in the SEM can be quantitatively described in terms of this effect. Studies with thin specimens of refractory carbides show that in these materials the carbon depletion is due to direct displacement processes and that here the electric fields give rise to recombination effects. The studies of ceramic thin films suitable for reference standards is continuing as a joint effort with the Rockwell Science Center. Work is in progress to describe the in plane crystallization that is observed in terms of the latent heat involved and the configurational entropy of the propagating interface.

15096 **(DOE/ER/45286—1) Fabrication, phase transformation studies and characterization of SiC-AlN-Al_2OC ceramics.** Virkar, A.V. (Utah Univ., Salt Lake City (USA). Dept. of Materials Science and Engineering). 1987. Contract FG02-87ER45286. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004053/JAW.

Work has progressed in three principal areas. These are (1) Phase transformation in SiC-AlN ceramics, (2) Phase equilibria and transformation in AlN-Al_2OC ceramics, (3) Elevated temperature creep in SiC-AlON ceramics and AlN. Principal characterization tools for the study of phase equilibria and transformation have been high resolution electron microscopy, microchemical analysis, optical microscopy and x-ray diffraction. 4 figs.

15087 **(DOE/ER/45297—5) Artificially structured superconductors: Annual progress report.** Falco, C.M. (Arizona Univ., Tucson (USA)). 19 Jan 1988. Contract FG02-87ER45297. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005345/JAW.

Progress since 1 April 1987 on high T/sub c/ films (oxide superconductors) is described. Planned research for next year is discussed. (DLC)

15088 **(DOE/OR/21400—T325) Formation of optical waveguides by ion implantation.** Poker, D.B. (Oak Ridge National Lab., TN (USA)). 20 Nov 1987. Contract AC05-84OR21400. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003894/JAW.

The use of ion implantation to introduce Ti into $LiNbO_3$ for the production of optical waveguides offers several advantages over the use of thermal diffusion. Higher concentrations and steeper gradients of dopant can be obtained, while reducing processing times and temperatures. However, the implantation process amorphizes the substrate, which must be regrown by solid phase epitaxy. This epitaxy was found to be extremely sensitive to the dopant species and concentration, which led to a search for species with better annealing characteristics. Though Ag and Pb allow regrowth at lower temperatures, the tendency of Ti to oxidize during regrowth is essential for the retention of dopant during annealing. Thus, the dopant exhibiting the slowest epitaxial regrowth ultimately produces the best waveguides.

15089 (INIS-BR—748, pp 129) **Detection of a ZrV_2H_4 hydride superstructure by EPR technique.** Cante, A.G.S.; Suassuna, J.F. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15090 (INIS-BR—748, pp 130) **Nuclear magnetic resonance in Zr $V_2H\gamma$ and $ZrCr_2Hx$ hydrides.** Brasil Filho, N.; Suassuna Filho, J. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15091 (INIS-BR—748, pp 130) **EPR of Gd^{3+} in AB_2H/sub x/ metallic hydrides.** Cante, M.V.; Suassuna, J.F. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15092 (INIS-BR—748, pp 131) **Influence of pressure in thermal treatments in the evolution of Fe-C Compounds obtained by ion implantation.** Oliveira, L.S. de; Silva, M.T.X.; Jornada, J.A.H. da. (Santa Catarina Univ., Florianopolis, Brazil; Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15093 (INIS-BR—748, pp 151) **Anisotropies in thin films.** Horowitz, F.; Sandoval, R.F. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15094 (INIS-BR—748, pp 159) **Absorption spectra and luminescence in Eu^+ as $GdAlO_3$ defect.** Padua, S.J.N. de; Oliveira Nunes, L.A. de; Castro, J.C. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15095 (INIS-BR—748, pp 165) **Study of divalent vanadium centers produced by irradiation in polycrystalline magnesium oxides.** Biasi, S. de; Fernandes, A.A.R. (Instituto Militar de Engenharia, Rio de Janeiro, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15096 (INIS-BR—748, pp 185) **Technology of tin oxide integrated circuits.** Mammana, C.I.Z.; Braga, E.S.; Mammana, A.P.; Kobayashi, S.; Tatsch, P.J.; Anderson, R.L.; Souza, C.P. de. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15097 (INIS-BR—748, pp 187) **Processes of corrosion in SnO_2 thin films by plasm and reactive ion.** Braga, E.S.; Farsch, P.J.; Mammana, A.P.; Mammana, C.I.Z. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15098 (INIS-BR—748, pp 190) **Vibratonal properties of a-Ge/sub 1-x/ N/sub x/.** Marques, F.C.; Schulz, P.A.B.; Sanjurjo, J.A.; Chambouleyron, I. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15099 (INIS-BR—748, pp 123) **Metastability of high pressure phase in ZrO_2.** Jornada, J.A.H. da; Block, S.; Piermarini, G.J. (Rio Grande do Sul Univ., Porto Alegre, Brazil; National Bureau of Standards, Washington DC). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15100 **(LA—10971-MS) Metal hydrides.** Carnes, J.R.; Kherani, N.P. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005083/JAW.

Metal hydride information is not available for most hydrides in a consolidated quick-reference source. This report's objective is to fill the need for such a document providing basic thermodynam-

ic data for as many metal hydrides as possible. We conduced a computerized library search to access as many sources as possible and screened each source for such thermodynamic data as pressure-temperature graphs, van't Hoff curves, and impurity effects. We included any other relevant information and commented on it. A primary concern to be investigated in the future is the behavior of metal tritides. This would be important in the area of emergency tritium cleanup systems. The hydride graphs are useful, however, as tritides may be expected in most cases to behave similarly and at least follow trends of their respective hydrides. 42 refs., 40 figs., 5 tabs.

15101 **(LBL—24140) Simulation and processing of high resolution images of defects and interfaces in superconducting $YBa_2Cu_3O_7$.** Zandbergen, H.W.; Gronsky, R.; Wang, K.; Thomas, G. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 10p. (CONF-871124—24). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003856/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The superconducting performance, in particular the critical current, of polycrystalline $YBa_2Cu_3O_7$ will depend strongly on the structure of grain boundaries and the nature and a number of defects in the microstructure. To characterize the atomic structure of defects and grain boundaries in these materials, a high rsolution electron microscopy study has been initiated. Emphasis has been placed on the technique of phase contrast imaging with corresponding computer simulation and processing for optimum interpretation of results. 3 figs.

15102 **(LBL—24196) The influence of thermal cycling on densification: Further tests of a theory.** Beruto, D.; Botter, R.; Searcy, A.W. (Lawrence Berkeley Lab., CA (USA); Genoa Univ. (Italy)). Oct 1987. Contract AC03-76SF00098. 11p. (CONF-8711115—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005266/JAW.

From 18. international conference on ceramic powder processing sciences; Orlando, FL, USA (1 Nov 1987).

The H_2O-catalyzed densification of MgO specimens which were thermally cycled between 1408°K and temperatures about 70° lower is compared to densification in specimens held isothermally. Both temperature gradients and rates of change in temperature were measured during cycling. The cycling produced densities marginally higher than expected from isothermal kinetics. Results are consistent with expectations from recent experiments with constant temperature gradients; the rate of temperature change does not appear to affect the densification rates significantly. Temperature differences are as high as 3 to 5°C between different positions on and in the 12 mm (one-half inch) specimens under nominally isothermal conditions. Such differences in temperature can provide a significant driving force for sintering in what are intended to be isothermal experiments.

15103 **(LBL—24251) Mass transport and chemical demixing of Y-Ba-Cu-O compounds during sintering in temperature gradients.** Rahaman, M.N.; De Jonghe, L.C.; Chu, May-Ying. (Missouri Univ., Rolla (USA). Dept. of Ceramic Engineering; Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004887/JAW.

A thin cylindrical powder compact (3mm diameter by 20mm) with a nominal composition of YBa_2Cu_3O/sub x/ was sintered in a static temperature gradient of 25°C/mm in air for 12 hours. The temperature at the hot end of the sample was maintained at 940 +- 5°C. Considerable mass transport and chemical demixing occurred along the length of the sample. The results are consistent with the formation of a liquid phase at the hot end of the sample, transport of the liquid down the temperature gradient and the formation different eutectic compositions along the length of the sample. The implications for processing high T/sub c/ superconductors in the system Y-Ba-Cu-O are discussed. 17 refs., 6 figs.

15104 **(MLM—3470) Transmission electron microscopy studies of titanium-containing braze/alumina seals.** Moddeman, W.E.; Cassidy, R.T.; Fraundorf, P.B. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 15 Jan 1988. Contract AC04-76DP00053. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005243/JAW.

A study was undertaken to determine interfacial compounds of an active braze/alumina seal by transmission electron microscopy to increase understanding of the role of titanium in the braze alloy. A high-resolution, 300 kV Phillips transmission electron microscope was used to examine the interfacial characteristics of a braze joint between an active braze alloy and a 94% Al_2O_3 ceramic. Results indicated the presence of both a copper-titanium compound and titanium oxide at the interface. These results agreed well with previous findings which, through the use of Auger electron spectroscopy and wavelength dispersive analysis, determined the presence of a copper-titanium compound (Cu/sub x/Ti where $1.2 < x < 1.6$) and titanium dioxide.

15105 **(PNL-SA—14607) Raman enhancement methods for molecular structure characterization of optical thin films.** Friedrich, D.M.; Exarhos, G.J. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 31p. (CONF-870388—16). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003421/JAW.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Mar 1987).

Because of the low Raman scattering probability and the short optical paths in films and interfaces, several techniques to enhance Raman signals have been developed. Among these are interference enhancement in multilayer structures, path length extension by wave guide methods, coherent nonlinear Raman spectroscopies, and resonant Raman enhancement by the use of short wavelength excitation. We discuss the advantages and limitations of interference and resonance enhancement methods. A common theme of both methods is the measurement of a Raman excitation profile spectrum by tuning the probe laser wavelength across an optical interference passband or across the electronic bandgap of the film material. Although interference is an optical effect which enhances the Raman spectrum uniformly, under resonance Raman conditions selective enhancement is observed for vibrational modes which are strongly coupled to the allowed electronic transitions in the dielectric material. The principal limitation of resonance Raman probes of solid films is the optical damage threshold which is easily exceeded by typical uv pulsed probe power levels near the electronic band edge. 10 refs., 10 figs.

15106 **(PNL-SA—14696) Slip casting of advanced ceramics and composites.** Schilling, C.H.; Aksay, I.A. (Pacific Northwest Lab., Richland, WA (USA); Washington Univ., Seattle (USA). Dept. of Materials Science and Engineering). Mar 1987. Contract AC06-76RL01830. 21p. (CONF-8702120—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003424/JAW.

From 3. workshop of the Canadian Industry/University Council on Advanced Ceramics; Montreal, Canada (25 Feb 1987).

Particle packing arrangements in slip cast (colloidal filtration) articles uniquely affect the evolution of grain size and porosity defect distributions during sintering. These particle packing arrangements are influenced by the physical properties of colloidal structures in suspension and the resulting processes of agglomerate restructuring and pore closure during consolidation. Key parameters affecting cast layer packing structures are the particle size distribution, interparticle potential, hydrodynamic stresses in suspensions, and the combined effect of hydrodynamic and compaction stresses in cast layers. Experiments with electrostatically stabilized aqueous alumina systems illustrate specific effects of interparticle potential on slip casting rates and microstructure evolution during sintering. In addition, experiments were conducted that illustrate microstructure variations caused by differential sedimentation velocities and agglomerate growth kinetic effects.

15107 **(PNL-SA—15182) The influence of processing variables on physical properties of sol-gel derived TiO_2 films.** Frydrych, W.S.; Ferris, K.F.; Exarhos, G.J. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 7p. (CONF-870878—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005155/JAW.

From Conference on atomic and molecular processing of electronic and ceramic materials: preparation, characterization and properties; Seattle, WA, USA (31 Aug 1987).

The nature of films deposited using sol-gel techniques depends upon the molecular structure of the solution, which is controlled by solution chemical equilibria and reaction kinetics. The influence of solution chemistry, solution reaction time, and thermal processing on the resulting phase of titania sol-gel films have been examined. Raman spectroscopy has been used to characterize the phase, phase homogeneity, and inherent stress in the films. An increased solution reaction time prior to film deposition was found to stabilize an amorphous TiO_2 phase to temperatures approaching 490°C. In addition, in situ time-resolved Raman spectroscopy has been used to examine the film crystallization process. 7 refs., 3 figs., 2 tabs.

15108 **(PNL-SA—15380) Processing relationships in YBa_2Cu_3O/sub 7-x/ superconductors.** Weber, W.J.; Pederson, L.R.; Maupin, G.D.; LeBlanc, E.J. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 5p. (CONF-871124—58). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005137/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Samples of YBa_2Cu_3O/sub 7-x/ were prepared by solid state reaction of Y_2O_3, BaO_2, and CuO powders mixed in stoichiometric proportions. Powders reacted at 900°C-925°C in air were pressed at 35 MPa into rectangular bars and sintered at 950°C in air for six hours. Slow cooling at 50°C/hour promoted complete transformation to the orthorhombic structure. The effects of subsequent oxidation processing on superconducting properties were also investigated. Oxidation anneals at one atmosphere pressure in flowing O_2 over the temperature range from 300 to 550°C were performed. Results indicate that oxidation at 450°C optimized the superconducting transition temperature at 91K with a 2-degree transition width. Subsequent high-pressure oxidation (2000 psi O_2) at 200°C for one week significantly degraded the superconducting characteristics. Results based on iodometric titration measurements and thermogravimetric analysis suggest that the copper valency is about 2.3 and oxygen stoichiometry is 6.94 ($x = 0.06$) in samples processed to optimize superconducting properties. 11 refs., 3 figs.

15109 **(RAL—87-053) Proceedings of a high temperature superconductivity strategy workshop.** Kurzfeld, A. (Rutherford Appleton Lab., Chilton (UK)). Jul 1987. 19p. (CONF-8704244—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751645/JAW.

From High temperature superconductivity strategy workshop; Chilton, UK (29 Apr 1987).

The paper contains the proceedings of a high temperature superconductivity strategy workshop, held at the Rutherford Appleton Laboratory, United Kingdom, 1987. The purpose of the meeting was to consider the U.K. strategy to be adopted for the high Tsub(c) superconductors and their application. The notes are presented of five Working Groups examining the following subjects: materials preparation, structural evaluation, physical properties, theoretical studies, and applications.

15110 **(SAND—87-1586C) Formation of buried nitride layers in (110) silicon.** Datye, A.K.; Kaushik, V.S.; Kendall, D.L.; Martinez-Tovar, B.; Myers, D.R. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-871124—42). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003255/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

High fluence ion implantation of N^+ (1×10^{18}/cm^2 at 150 keV) has been used to form buried nitride layers in (110) silicon. After annealing at 1200 C for 5 h, a continuous polycrystalline alpha-silicon nitride layer (200 nm thick) is observed beneath a surface silicon film 150 nm thick. The upper Si/Si_3N_4 interface appears to be more abrupt than that observed in (100) silicon with minimal dendritic intergrowth and no evidence for microtwinning in the silicon. Furthermore, a bond of nitride precipitates can be detected 500 nm below the continuous nitride layer. These nitride precipitates grow semi-coherently within the silicon with no observable strain or misfit dislocations within the silicon. The nitride precipitates are internally faulted to accommodate the 10% lattice mismatch in the (0001) nitride direction. Short-term anneals reveal that the precipitates have fully crystallized within 10 min. at 1200 C while the continuous nitride layer is still amorphous. 11 refs., 3 figs.

15111 **(SAND—87-2482C) Improved magnetization for YBa_2Cu_3O/sub 7-δ/ annealed in oxygen above 1000°C.** Venturini, E.L.; Ginley, D.S.; Baughman, R.J.; Morosin, B.; Kwak, J.F. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1987. Contract AC04-76DP00789. 4p. (CONF-871124—30). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003934/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Air sintering and subsequent oxygen annealing at high temperatures are integral to the production of ceramic superconducting YBa_2Cu_3O/sub 7-δ/. We present results directed toward optimizing the temperature for these two process steps, using static magnetization to determine the intragranular properties. Surprisingly, pure oxygen stabilized the material against decomposition at temperatures near the melting point, allowing the production of significantly higher quality single phase material. 13 refs., 2 figs.

15112 **(SAND—87-2773C) Atom probe microanalysis of superconducting YBa_2Cu_3O/sub 7-x/.** Brenner, S.S.; Kellogg, G.L. (Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering; Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-8711114—1). NTIS, PC A02. Order Number DE88003203/JAW.

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Superconducting YBa_2Cu_3O/sub 7-x/ needles prepared from hot-pressed discs of oxide powders were analyzed in a long drift-tube type atom probe. The analyses were made of randomly located areas about 2 nm in diameter. Most of the oxygen field-evaporated as O_2^+ ions. The measured composition agreed well with the theoretical one expected of YBa_2Cu_3O/sub 6.5/ except for yttrium which was found to be too high. The composition profiles showed concentration fluctuations about 2.5 nm apart which must still be clarified. 2 refs., 4 figs., 1 tab.

15113 **(SRD-R—405) Alpha particle damage in oxide nuclear fuel.** Elton, P.T. (UKAEA Safety and Reliability Directorate, Culcheth). Jan 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750327/JAW.

Price Pound 4.00.

A model for the ingrowth of Frenkel defects in alpha particle irradiated uranium dioxide is proposed. It is assumed that interstitials and vacancies spontaneouly recombine at room temperature if they are separated by a single cation jump. A statistical calculation using large computer arrays to simulate the geometry of the lattice enables the defect concentration to be obtained as a function of atomic displacements. Comparison of the model to experimental lattice parameter data for UO_2 enables the number of stable cation Frenkel pairs produced per alpha particle determined to be around 25. This figure is supported by independent evidence. The differing damage behaviour of single and polycrystalline material is discussed and is attributed to the difference in original microstructures. A computer simulation of a damaged lattice is used to deduce the annealing behaviour of point defects during post-irradiation heating. It is deduced that the observed lattice dilation is primarily due to cation defects and that up to three annealing stages will be observed. The stages are, with increasing temperature, 'correlated' recombination, vacancy migration and finally dissociation of clustered vacancies and/or migration of cation interstitials.

15114 **Flux penetration profiles in powdered $DyBa_2Cu_3O_7$.** Daeumling, M.; Seuntjens, J.; Larbalestier, D.C. (Applied Superconductivity Center, University of Wisconsin-Madison, Madison, Wisconsin). *Applied Physics Letters;* 52: No. 7, 590-591(15 Feb 1988).

Flux penetration measurements on powdered specimens of $DyBa_2Cu_3O_7$ have been performed by using Campbell's [J. Phys., C 2, 1492 (1969)] method at 4.2 K in magnetic fields up to 7 T. There are three principal results of the measurements. The first is that although there is a small region of surface current, there is indeed a linear bulk flux profile. Thus there is a uniform bulk current flowing through the sample, and the Bean model is appropriate for these compounds. The second result is that the magnetic moment is independent of particle size (over the range 3—12 μm), even when the powders are single crystals. This implies that the currents are subdivided on a scale finer than the grain size. The third result is that J/sub c/ (4.2 K, 1—7 T) is very high, reaching 10^7 A/cm^2.

15115 **Critical current enhancement in NbN/AlN multilayers.** Murduck, J.M.; Capone D.W. II; Schuller, I.K.; Foner, S.; Ketterson, J.B. (Material Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Applied Physics Letters;* 52: No. 6, 504-506(8 Feb 1988). Contract W-31-109-ENG-38;FG03-87ER45332.

Measurements are presented of the critical current density, J/sub c/, and parallel upper critical field, H/sub c/$_2$/sub parallel/, for the refractory superconductor/insulator multilayer system NbN/AlN. A dramatic increase in J/sub c/, together with an increase of H/sub c/$_2$/sub parallel/, is observed with decreasing NbN layer thickness. The J/sub c/ enhancement arises from flux pinning in the AlN or at the NbN-AlN interface, not at defects in the NbN structure. The results indicate that the development of superconductor/insulator composites is a viable strategy to increase the critical current. Thermal stabilization which does not degrade the very high J/sub c/ values was also accomplished in a novel structure by addition of copper layers within the superlattice.

15116 **Gases released by surface flashover of insulators.** Miller, H.C.; Ney, R.J. (General Electric Company, Neutron Devices Department, P.O. Box 2908, Largo, Florida 34649). *Journal of Applied Physics;* 63: No. 3, 668-673(1 Feb 1988).

The gases released by surface flashovers on alumina ceramics, glass, and quartz, using 20-μs voltage pulses, were investigated using an ion-pumped metal vacuum system. Appreciable quantities of gas were measured (approximately 10^{-6} Torr liter or 10^{18} molecules). The composition of this gas differed significantly from the background gas. The dominant species in the surface flashover gases were CO_2, CO, and H_2; a modest amount of CH_4 was observed, along with lesser quantities of N_2 and H_2O. The dominant gas in the system background was nitrogen, accompanied by (in decreasing amounts) H_2, H_2O, CO/CO_2, Ar, CH_4, and He. We concluded that the gas released by flashovers on the surface of the insulators was not adsorbed system background gas, but was gas adsorbed during the handling and processing of the insulator.

15117 **Ground-state analysis of ordered superstructures in the basal plane of YBa_2Cu_3O/sub z/.** Wille, L.T.; de Fontaine, D. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory Department of Materials Science and Mineral Engineering, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 4, 2227-2230(1 Feb 1988).

Ordered superstructures consisting of occupied and empty oxygen sites in the Cu-O basal plane of YBa_2Cu_3O/sub z/ have been determined. Pairwise interactions (V_1, V_2, V_3) between nearest- and next-nearest-neighbor sites are assumed and ordering maps are plotted as a function of V_2/V_1 and V_3/V_1 (in the ordering case: $V_1>0$). The ground state of this Ising model is determined by a direct enumeration method and the relation with experimentally obtained structures is discussed.

15118 **Phase diagram of the superconducting oxide YBa_2Cu_3O/sub 6+//sub δ/.** Khachaturyan, A.G.; Semenovskaya, S.V.; Morris J.W. Jr. (Center for Advanced Materials, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 4, 2243-2246(1 Feb 1988).

The superconducting oxide YBa_2Cu_3O/sub 6+//sub δ/ is found in two structures: a tetragonal structure (T) that is stoichiometric when $\delta = 0$, and an orthorhombic (O) structure stoichiometric when $\delta = 1$. Assuming that only these phases appear in the phase diagram of the oxide as temperature (t) and δ are varied, it is shown that the phase diagram must have one of two relatively simple forms. The first has a T field at high t and low δ, an O field at lower temperature and high δ, and a T+O two-phase field that separates the two at low t. The second has these features, and also includes an O+O′ two-phase field that results from a miscibility gap in the O phase. A mean-field model is fit to the experimental data, and suggests that the second type of diagram is correct. The calculated phase diagram is presented. The variation of the oxygen partial pressure with δ and t is also discussed.

15119 **High-resolution x-ray microstructural study of single crystals of YBa_2Cu_3O/sub 7-//sub δ/.** You, H.; Axe, J.D.; Kan, X.B.; Moss, S.C.; Liu, J.Z.; Lam, D.J. (Department of Physics, Brookhaven National Laboratory, Upton, New York, 11973). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 4, 2301-2304(1 Feb 1988).

Single crystals of YBa_2Cu_3O/sub 7-//sub δ/ were studied by transmission Laue photography and monochromatic diffraction techniques, using the Cornell High Energy Synchrotron Source and a conventional rotating anode x-ray source. Two types of twinning were observed: the well-known (110)-type twinning in one sample and a 90° twinning about the c axis in another crystal whose superconducting properties were excellent, thereby precluding the necessity of (110) twins for high T/sub c/. Diffraction experiments on the sample with the (110) twins reveal subgrains, each of which has a value of the orthorhombic parameter (a-b)/a differing by as little as 0.003 from the others. Such a microstructure distribution suggests a multiphase character and is discussed in relation to recent evidence of granular superconductivity.

15120 **Temperature-dependent far-infrared reflectance of La-Sr-Cu-O and La-Ca-Cu-O: Bardeen-Cooper-Schrieffer electrodynamics but uncertain energy gap.** Sherwin, M.S.; Richards, P.L.; Zettl, A. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 4, 1587-1593(1 Feb 1988).

The available far-infrared data for polycrystalline La-Sr-Cu-O and La-Ca-Cu-O show a reflectance edge with energy near 2.5k/sub B/T/sub c/. This edge has been variously interpreted as the onset of absorption due to an energy gap, and as a low-frequency plasma edge caused by strong far-infrared resonances. Our measured temperature dependence of the reflectance edge closely fits the temperature dependence of the order parameter in a mean-field theory, and hence is consistent with the energy-gap hypothesis. In this paper, we construct a model dielectric function for La/sub 1.85/Sr/sub 0.15/CuO_4 which is consistent with mean-field theory and the hypothesis of a plasma edge. We find that the temperature dependence of the plasma frequency in this model also closely fits the measured temperature dependence of the reflectance edge. Furthermore, both hypotheses accurately predict the experimentally observed temperature dependence of the absorption at frequencies much less than the reflectance edge. This observation has significant implications for the construction of fast low-loss superconducting devices. We conclude that the electrodynamics of the superconducting transition in La/sub 1.85/Sr/sub 0.15/CuO_4 are well described by a Bardeen-Cooper-Schrieffer-like mean-field theory. However, given the identical predictions of the energy-gap and plasma-edge hypotheses, it is premature to deduce a precise value for the magnitude of the energy gap from the infrared data.

15121 Q-factor measurements of the bulk resistivity and nonmetal-metal transitions in LaH/sub x/ and CeH/sub x/ (x≧2.70). Shinar, J.; Dehner, B.; Beaudry, B.J.; Peterson, D.T. (Ames LaboratoryU.S. Department of Education, Department of Physics and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **37**: No. 4, 2066-2073(1 Feb 1988). Contract W-7405-ENG-82.

The resistivity rho(T) of CeH/sub x/, x = 2.70, 2.78, and LaH/sub x/, x = 2.70, 2.80 2.90, and 2.93, was measured in the temperature range 100≦T≦500 K, using an indirect Q-meter technique. The measured values of CeH/sub 2.78/ are in excellent agreement with the previous direct-contact measurements of Libowitz, Pack, and Binnie. In all cases except LaH/sub 2.93/, rho(T) peaks at 240≦T≦270 K, in rough agreement with the onset of the slight tetragonal distortion of the fcc phase and/or the formation of an ordered hydrogen superlattice. Thus, the temperature coefficient of the resistivity α is positive below the peak but negative above. In LaH/sub 2.90/ the peak is very sharp and the behavior semiconductinglike above 250 K. In LaH/sub 2.93/ the behavior is semiconductinglike throughout the measured range. The room-temperature resistivity of LaH/sub x/ rises sharply with x, from around 7 x 10/sup -4/ Ω cm at x = 2.70 to around 0.5 Ω cm at x = 2.93. These results are discussed in light of previous experimental results and band-structure calculations of LaH_2 and LaH_3. It is suggested that the peak in rho(T) is induced by an order-disorder transition, and the density of states at the Fermi level rapidly decreases to zero and a gap is consequently opened up as the concentration x approaches the trihydride stoichiometric limit.

15122 Positron-annihilation studies of the superconductivity transition in YBa_2Cu_3O/sub 7-//sub x/. Smedskjaer, L.C.; Veal, B.W.; Legnini, D.G.; Paulikas, A.P.; Nowicki, L.J. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **37**: No. 4, 2330-2333(1 Feb 1988). Contract W-31-109-ENG-38.

Positron-annihilation studies, by Doppler broadening, of the superconducting transition in YBa_2Cu_3O/sub 7-//sub x/(x≧0.1) have been made. Below T/sub c/ a large positive temperature dependence of the lineshape parameter is observed, while at (or near) T/sub c/ an almost discontinuous increase in the lineshape parameter takes place. The behavior below T/sub c/ may be consistent with a Bardeen-Cooper-Schrieffer-like theory if an energy band with a small dispersion crosses the Fermi level. The discontinuity is not clearly understood, but may be due to a major change in the electronic structure taking place with the onset of superconductivity.

15123 Possible twin-boundary effect upon the properties of high-T/sub c/ superconductors. Fang, M.M.; Kogan, V.G.; Finnemore, D.K.; Clem, J.R.; Chumbley, L.S.; Farrell, D.E. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **37**: No. 4, 2334-2337(1 Feb 1988).

We have studied the field at which superconductivity nucleates in grain-aligned samples of $Y_1Ba_2Cu_3O$/sub 7-//sub δ/ very close to the transition temperature T/sub c/. For the field parallel to the c axis and for temperatures within 2 K of T/sub c/, the nucleation field is found to vary as (1-T/T/sub c/)/sup 1/2/. The data suggest that superconductivity localized near twin boundaries may exist at temperatures close to T/sub c/. .AE

15124 Magnetic ordering in the high-temperature superconductor $GdBa_2Cu_3O_7$. Paul, D.M.; Mook, H.A.; Hewat, A.W.; Sales, B.C.; Boatner, L.A.; Thompson, J.R.; Mostoller, M. (Department of Physics, University of Warwick, Coventry CV4 7AL, United Kingdom). *Physical Review [Section] B: Condensed Matter;* **37**: No. 4, 2341-2344(1 Feb 1988).

Neutron diffraction has been employed to study the magnetic ordering in the high-temperature superconducting compound $GdBa_2Cu_3O_7$. The compound is found to undergo an antiferromagnetic transition with the Gd magnetic moments ordering at 2.22 +- 0.07 K. The ordering is shown to be three dimensional with a doubling of the orthorhombic unit in all three directions. An analysis of the intensities of the observed magnetic Bragg reflections shows that the ordered magnetic moment per Gd atom is 7.4 +- 0.6μ/sub B/ and lies along the c axis of the orthorhombic cell. It is unlikely that dipolar ordering can explain the occurrence of this magnetic phase transition where the system locks into a three-dimensional ordered arrangement at the Neel temperature, since the separation of the Gd atoms along the c axis is approximately three times that along the a,b axes.

15125 Fast-neutron irradiation of YBa_2Cu_3O/sub x/. Cost, J.R.; Willis, J.O.; Thompson, J.D.; Peterson, D.E. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **37**: No. 4, 1563-1568(1 Feb 1988).

We have studied the effects of fast neutron (E>0.1 MeV) irradiation on the superconducting properties of polycrystalline YBa_2CU_3O/sub x/ with x = 7 +- 0.1. For fluences less than 1 x 10/sup 18/ n/cm², the superconducting transition temperature T/sub c/ decreases at a linear rate of about 3.0 K/10/sup 18/ n/cm². Measurements of the critical magnetization current density J/sub c/ at 7 K and zero field show an increase by a factor of three to 4.4 x 10^4 A/cm² at 1 x 10/sup 18/ n/cm² fluence and larger relative increases at high fields. At 75 K, J/sub c/ is also enhanced with neutron irradiation, although the absolute values of J/sub c/ are nearly two orders of magnitude smaller than at 7 K.

15126 Decoration of flux pinning positions in YBa_2Cu_3O/sub 7-//sub δ/ superconductors. Jou, C.J.; Weber, E.R.; Washburn, J.; Soffa, W.A. (Department of Materials Science and Mineral Engineering, University of California, Berkeley, California 94720, and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Applied Physics Letters;* **52**: No. 4, 326-327(25 Jan 1988). Contract AC03-76SF00098.

Flux pinning in the sintered high T/sub c/ oxide superconductors, YBa_2Cu_3O/sub 7-//sub δ/, in the vortex state has been demonstrated for the first time using the Bitter pattern technique and scanning electron microscopy. External magnetic fields of 150 or 800 G perpendicular to the specimen surfaces were applied during the evaporation of cobalt after the specimens cooled with liquid nitrogen had reached a temperature below T/sub c/. All specimens thus decorated with cobalt show nonuniformly distributed flux pinning positions as would be expected due to the porosity and multiphase character of the specimens as well as the relatively low field applied.

15127 Method for making low-resistivity contacts to high T/sub c/ superconductors. Ekin, J.W.; Panson, A.J.; Blankenship, B.A. (Electromagnetic Technology Division, National Bureau of Standards, Boulder, Colorado 80303). *Applied Physics Letters;* **52**: No. 4, 331-333(25 Jan 1988).

A method for making low-resistivity contacts to high T/sub c/ superconductors has been developed, which has achieved contact surface resistivities less than 10 μΩ cm² at 76 K and does not require sample heating above ~150 °C. This is an upper limit for the contact resistivity obtained at high current densities up to 10^2—10^3 A/cm² across the contact interface. At lower measuring current densities the contact resistivities were lower and the voltage-current curve was nonlinear, having a superconducting transition character. On cooling from 295 to 76 K, the contact resistivity decreased several times, in contrast to indium solder contacts where the resistivity increased on cooling. The contacts showed consistently low resistivity and little degradation when exposed to dry air over a four-month period and when repeatedly cycled between room temperature and 76 K. The contacts are formed by sputter depositing a layer of a noble metal-silver and gold were used-on a clean superconductor surface to protect the surface and serve as a contact pad. External connections to the contact pads have been made using both solder and wire-bonding techniques.

15128 Surface compositional and topographical changes resulting from excimer laser impacting on $YBa_2Cu_3O_7$ single phase superconductors. Auciello, O.; Krauss, A.R.; Santiago-Aviles, J.; Schreiner, A.F.; Gruen, D.M. (North Carolina State University, Department of Nuclear Engineering, Raleigh, North Carolina 27695-7909). *Applied Physics Letters;* **52**: No. 3, 239-241(18 Jan 1988).

Superconducting pressed pellets of $YBa_2Cu_3O_7$ (T/sub c/ = 90 K), which were used as ablation targets for laser-induced vapor deposition of high T/sub c/(85 K) superconducting thin films, have been analyzed by secondary electron microscopy, scanning Auger microscopy, energy dispersive x-ray analysis, and x-ray diffractometry. The elemental distribution of Y, Ba, and Cu appears reasonably uniform at depths corresponding to that probed by energy dispersive x-ray analysis (~1 μm). However, scanning Auger microscopy analysis of the laser-impacted area shows a significant depletion of Cu and spatial redistribution of Y, Ba, Cu, and O on the target surface. X-ray diffractometry of the laser-impacted area shows the appearance of a new broad peak at a diffraction angle $2\theta = 29.7°$, characteristic of BaY_2O_4 and a poorly defined peak at $2\theta = 29.3°$, that can be attributed to $BaCuO_2$. A possible influence of the laser-induced bulk superconductor compositional changes on the film composition is discussed in relation to recently reported experimental results on laser vapor deposition of high T/sub c/ films.

15129 Raman spectroscopic investigation of superconducting $YBa_2Cu_3O_7$/sub -//sub x/, semiconducting $YBa_2Cu_3O_6$/sub +//sub x/, and possible impurity phases. Mascarenhas, A.; Geller, S.; Xu, L.C.; Katayama-Yoshida, H.; Pankove, J.I.; Deb, S.K. (Solar Energy Research Institute, Golden, Colorado 80401). *Applied Physics Letters;* **52**: No. 3, 242-243(18 Jan 1988).

A Raman spectroscopic investigation of specimens of superconducting YBa_2Cu_3O/sub 7-//sub x/ and of the possible impurity phases YBa_2Cu_3O/sub 6+//sub x/ (semiconductor), Y_2BaCuO_5, $Y_2Cu_2O_5$, $BaCuO_2$, CuO, Y_2O_3, and $BaCO_3$ indicates that in the range 100—700 cm^{-1}, there are six characteristic lines belonging to the superconductor. At 13 K, these lines are at 150, 338, 441, 507, 590, and 644 cm^{-1}. Comparison of the Raman spectra of the superconductor and the semiconductor indicates a mode stiffening of the pair at 338 and 441 cm^{-1}, but a mode softening of the pair at 507 and 590 cm^{-1}. A factor group analysis leads to a tentative assignment of the Raman and infrared allowed modes.

15130 Computer simulation of interactions of model Pt particles and films with the silica surface. Levine, S.M.; Garofalini, S.H. (Department of Ceramics, Rutgers University, Piscataway, New Jersey 08854). *Journal of Chemical Physics;* **88**: No. 2, 1242-1247(15 Jan 1988).

The molecular dynamics method was used to simulate adsorption and particle growth behavior of model Pt metal on the vitreous silica surface. Analysis of depositions from single atoms through the development of a continuous film of metal were simulated, and were then compared to similar systems analyzed in the laboratory. Consistent with experimental findings, the single atom depositions showed both adsorption onto the surface of the substrate as well as penetration into the interior (subsurface) sections. Multiple Pt atom interactions resulted in more complex absorption behavior. This finding yielded better quantitative agreement with the "real" systems analyzed previously. Applications of this type of study are discussed.

15131 Luminescence of heteroepitaxial zinc oxide. Bethke, S.; Pan, H.; Wessels, B.W. (Department of Materials Science and Engineering, and Materials Research Center, Northwestern University, Evanston, Illinois 60208). *Applied Physics Letters;* **52**: No. 2, 138-140(11 Jan 1988).

Thin layers of ZnO were grown on (0001) oriented sapphire by organometallic chemical vapor deposition. Low-temperature photoluminescence indicates that near-band-edge luminescence dominates the spectrum. In contrast to bulk grown material deep level luminescence for the layers is relatively weak.

15132 Neutron-diffraction determination of antiferromagnetic structure of Cu ions in YBa_2Cu_3O/sub 6+//sub x/ with x = 0.0 and 0.15. Tranquada, J.M.; Cox, D.E.; Kunnmann, W.; Moudden, H.; Shirane, G.; Suenaga, M.; Zolliker, P.; Vaknin, D.; Sinha, S.K.; Alvarez, M.S.; and others. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **60**: No. 2, 156-159(11 Jan 1988). Contract AC02-76CH00016.

Neutron-diffraction experiments on ceramic powders of YBa_2Cu_3O/sub 6+//sub x/ (nonsuperconducting, with x = 0.0 and 0.15) have confirmed the existence of long-range, three-dimensional, antiferromagnetic order of the Cu spins. The structure determination was aided by the use of uniaxially oriented powders. The ordering wave vector within a CuO_2 plane is (1/21/2) and the planes are coupled antiferromagnetically along the c axis. The Neel tempreature is 400 +- 10 K for the x = 0.15 +- 0.05 sample and approx. >500 K for x = 0.0.

15133 X-ray and neutron diffracton study of $La_1Ba_2Cu_3O$/sub 9-//sub δ/: Influence of the Cu-O structure on T/sub c/. Song, Y.; Golben, J.P.; Chittipeddi, S.; Lee, S.I.; McMichael, R.D.; Chen, X.D.; Gaines, J.R.; Cox, D.L.; Epstein, A.J. (Department of Physics, Ohio State University, Columbus, Ohio 43210). *Physical Review [Section] B: Condensed Matter;* **37**: No. 1, 607-610(1 Jan 1988).

X-ray and neutron diffraction studies on $La_1Ba_2Cu_3O$/sub 9-//sub δ/ demonstrate that the structure of this compound closely resembles that of $Y_1Ba_2Cu_3O$/sub 9-//sub δ/. The importance of oxygen ordering on the outer Cu planes for high-T/sub c/ superconductivity is stressed. Broadening in the diffraction peaks as T/sub c/ is decreased is indicative of greater disorder in the La or Ba sites and/or the oxygen configuration. Evidence for the existence of octahedral Cu-O configurations between unit cells, possibly associated with a Ba-doped La/sub 3-//sub x/Ba_3/sub 3+//sub x/Cu_3O/sub 14+//sub y/ (x = 1) phase, is minimal.

15134 Ginzburg-Landau parameters for an $ErRh_4B_4$ single crystal. Behroozi, F.; Crabtree, G.W.; Hall, L.N.; Hinks, D.G. (Department of Physics, University of WisconsinParkside, Kenosha, Wisconsin 53141). *Physical Review [Section] B: Condensed Matter;* **37**: No. 1, 50-53(1 Jan 1988).

The generalized Ginzburg-Landau parameters κ_1 and κ_3 have been determined for the primitive tetragonal phase of $ErRh_4B_4$ from magnetization curves of a single-crystal sphere. Along the magnetically hard c direction, $\kappa_{1a}=\kappa_3 = 4.5$ near T/sub c/, but rise gently with decreasing temperature to a value of 6 as the ferromagnetic transition temperature T/sub f/ is approached. Along the magnetically easy a direction, κ_{1a}=4.5 at T/sub c/ but drops anomalously as T/sub f/ is approached, reflecting the tendency of the system to a type-I superconductor. Furthermore, along the c direction where the effect of magnetism is mild and the system behaves similar to an ordinary type-II superconductor, the penetration depth $\lambda(0)$ and the coherence distance $\xi(0)$ are estimated to be 830 and 180 A, respectively.

15135 Electronic behavior of oxygen-deficient YBa_2Cu_3O/sub 7-//sub δ/. Kwok, W.K.; Crabtree, G.W.; Umezawa, A.; Veal, B.W.; Jorgensen, J.D.; Malik, S.K.; Nowicki, L.J.; Paulikas, A.P.; Nunez, L. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **37**: No. 1, 106-110(1 Jan 1988).

We have measured the resistivity, Meissner effect, and neutron powder diffraction on a series of samples of YBa_2Cu_3O/sub 7-//sub δ/ quenched into liquid nitrogen from temperatures between 400 and 900 °C in order to study the dependence of the electronic and structural properties on oxygen content. The normal-state resistivity is linear only for samples with high superconducting transition temperatures, becoming concave upward for samples with low T/sub c/, and semiconducting for nonsuperconducting samples quenched from high temperatures. Structural analysis shows dramatic movements of the bridging oxygen atom [O(4)] and the copper atom [Cu(2)] in the two-dimensional planes as the oxygen stoichiometry is reduced.

15136 **Magnetic form factor of Cu in La_2CuO_4.** Freltoft, T.; Shirane, G.; Mitsuda, S.; Remeika, J.P.; Cooper, A.S. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* 37: No. 1, 137-142(1 Jan 1988).

The magnetic form factor for Cu in a single crystal of the antiferromagnet La_2CuO_4 has been measured using neutron diffraction. The result is consistent with the Calculation of Freeman and Watson for Cu/sup 2+/ at least up to Q = 4 A/sup -1/, although a plateau between 1 and 3 A/sup -1/ suggests a small contribution of moment at the out-of-plane oxygen sites. For larger values of Q the form factor for La_2CuO_4 drops faster than for Cu/sup 2+/. The sample ordered antiferromagnetically at T/sub N/≃185 K with an average ordered moment $\mu = 0.30$ μ/sub B/ per Cu atom.

15137 **Band-theoretical study of magnetism in Sc_2CuO_4.** Leung, T.C.; Wang, X.W.; Harmon, B.N. (Ames LaboratoryU.S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* 37: No. 1, 384-388(1 Jan 1988). Contract W-7405-ENG-82.

Self-consistent, spin-polarized calculations were performed for Sc_2CuO_4. Both ferromagnetic and antiferromagnetic ground states were investigated and found to be unstable. Magnetic form factors were calculated and are discussed in view of experiments on La_2CuO_4 and the applicability of band theory.

15138 **Cu-induced surface disruption of La/sub 1.85/Sr/sub 0.15/CuO_4.** Hill, D.M.; Gao, Y.; Meyer H.M. III; Wagener, T.J.; Weaver, J.H.; Capone D.W. II. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review [Section] B: Condensed Matter;* 37: No. 1, 511-514(1 Jan 1988).

Interface reactions for vapor-deposited Cu on La/sub 1.85/Sr/sub 0.15/CuO_4 were investigated with x-ray photoemission and inverse photoemission. Strong Cu-O reactions indicate oxygen removal and the Cu 2p/sub 3/2/ emission shows conversion of the superconductor Cu/sup 2+/ configuration to Cu/sup 1+/ within 40—50 A of the surface. Valenc-band results show a loss of the Cu 3d/sub x//sub <2/-y/sup =/—O 2p/sub x//sub ,//sub y/ electronic states near the Fermi level, and we conclude that the surface layer is not superconducting. Changes in the occupied empty electronic states of La at low Cu coverages provide additional evidence of Cu-induced reaction. A metallic overlayer begins to form at ~2 A nominal Cu coverage as these surface reactions become diffusion limited at room temperature.

15139 **Interface formation of semiconductors with high-T/sub c/ superconductors: Ge/La/sub 1.85/Sr/sub 0.15/CuO_4.** Gao, Y.; Wagener, T.J.; Weaver, J.H.; Capone D.W. II. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review [Section] B: Condensed Matter;* 37: No. 1, 515-518(1 Jan 1988).

Inverse photoemission has been used to probe the microscopic evolution of the semiconductor/superconductor interface Ge/La/sub 1.85/Sr/sub 0.15/CuO_4. We find little or no reaction until the Ge coverage reaches 1 A and that the reaction is quickly saturated when the nominal coverage reaches ~6 A. The reaction is characterized by the reduction of the Cu 3d—O 2p antibonding electronic states straddling the Fermi level and the shift of La 4f and 5d empty-state features toward E/sub F/. Large apparent electron mean free paths deduced from the attenuation of La peaks suggest cluster and island formation in the Ge/La/sub 1.85/Sr/sub 0.15/CuO_4 interface.

15140 **Observation of alignment of superconducting $YBa_2Cu_3O_7$ particles in a magnetic field using neutron diffraction.** Tranquada, J.M.; Goldman, A.I.; Moodenbaugh, A.R.; Shirane, G.; Sinha, S.K.; Jacobson, A.J.; Lewandowski, J.T. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* 37: No. 1, 519-521(1 Jan 1988). Contract AC02-76CH00016.

Neutron-diffraction measurements have been performed on powdered, sintered-pellet, and pressed-powder samples of $YBa_2Cu_3O_7$ in the superconducting mixed state. In the powdered sample, the presence of the vertical applied magnetic field is found to cause an irreversible increase in the intensity of the (001) Bragg peak measured in the horizontal plane. This effect is consistent with orientation of the particles in the field. No changes due to the field are observed in the sintered pellet or the pressed powder.

15141 **Magnetic ordering of Gd and Cu in superconducting and nonsuperconducting $GdBa_2Cu_3O$/sub 7-//sub δ/.** Dunlap, B.D.; Slaski, M.; Sungaila, Z.; Hinks, D.G.; Zhang, K.; Segre, C.; Malik, S.K.; Alp, E.E. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* 37: No. 1, 592-594(1 Jan 1988). Contract W-31-109-ENG-38.

An investigation of the magnetic properties of superconducting and nonsuperconducting samples of $GdBa_2Cu_3O$/sub 7-//sub δ/ has been carried out. The antiferromagnetic transition temperature for the Gd ions in the material is the same for both compounds (2.2 K) although the superconducting compound shows metallic behavior and the nonsuperconducting compound shows semiconducting behavior. This provides direct evidence for the lack of magnetic interactions mediated by conduction electrons in these materials. In the nonsuperconducting material, evidence is obtained for the presence of antiferrromagnetic ordering in the Cu sublattice at a temperature of 18 K.

15142 **Oxygen diffusion in La/sub 2-//sub x/Sr/sub x/CuO/sub 4-//sub y/.** Routbort, J.L.; Rothman, S.J.; Flandermeyer, B.K.; Nowicki, L.J.; Baker, J.E. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Materials Research;* 3: No. 1, 116-121(Jan 1988). Contract W-31-109-ENG-38.

Diffusion of ^{18}O in the superconductor La/sub 2-//sub x/Sr/sub x/CuO/sub 4-//sub y/ has been measured as a function of x (0 to 0.20) between 300 and 500 °C at an oxygen partial pressure of ≃1 atm. Concentration profiles were obtained using a secondary ion mass spectrometer. The diffusion coefficient decreases with increasing Sr additions from 0.1 to 0.2, primarily because of an increase in activation energy. This result, which is contradictory to the expectation that the diffusion coefficient should increase with increasing vacancy concentration caused by the added Sr, can be explained if oxygen vacancies are bound to Sr clusters. Measurements on samples with x = 0 or 0.05 were unsuccessful, probably because of porosity.

15143 **Radiation damage in boron nitride x-ray lithography masks.** King, P.L.; Pan, L.; Pianetta, P.; Shimkunas, A.; Mauger, P.; Seligson, D. (Stanford Synchrotron Radiation Lab, SLAC Bin 69, PO Box 4349, Stanford, California 94305). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* 6: No. 1, 162-166(Jan 1988).

The optical and mechanical properties of boron nitride vapor deposited at 400 °C are shown to degrade when exposed to synchrotron radiation. The extent of the damage and the rate at which the damage occurs are similar to that first reported by Johnson et al. Transmission through membranes of boron nitride was measured in situ during exposure to x rays. Membranes darkened considerably with the transmission through a typical membrane falling from 50% to 20% after absorbing ~250 kJ/cm³ of x rays. Changes in local film stress were measured with a simple cantilever technique. Films originally in tension (~5E8 dyne/cm²) were found to become compressive after absorbing 300 kJ/cm³ of x rays. Both forms of damage responded well to annealing. Fourier transform infrared (FTIR) and near-edge x-ray absorption measurements were made to discern the structural differences between degraded and unexposed films. No significant structural changes were observed. Boron nitride films deposited at higher temperatures (600 °C) proved to be much less susceptible to radiation damage. In a related development, films produced through the pyrolysis of borazine appeared to be completely immune to radiation damage as were silicon and silicon nitride membranes. FTIR spectra indicate that less hydrogen is present in the 600 °C chemical-vapor deposi-

tion (CVD) and the pyrolytic boron nitride films than in the 400 °C CVD films. As proposed by Johnson et al., hydrogen is implicated as an intermediary in the boron nitride damage mechanism.

15144 **Atomic structure of symmetric tilt grain boundaries in NiO.** Merkle, K.L.; Smith, D.J. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **59**: No. 25, 2887-2890(21 Dec 1987). Contract W-31-109-ENG-38.

High-resolution electron microscopy shows the coexistence of several distinct core structures for coincident-site lattice boundaries in NiO bicrystals near $\Sigma = 5$, (310), and $\Sigma = 13$, (510). Lattice expansion perpendicular to the $\Sigma = 5$ grain boundaries is considerably smaller than calculated theoretically. Structural units in boundaries near $\Sigma = 13$, (510) exhibit translations normal to the grain boundary plane, resulting in a rumpling of the interface on an atomic scale. Our observations suggest the presence of a high concentration of Schottky pairs in the grain boundaries.

15145 **Superconducting H/sub x/$YBa_2Cu_3O_7$: The role of H.** Yang, C.Y.; Yang, X.; Heald, S.M.; Reilly, J.J.; Skotheim, T.; Moodenbaugh, A.R.; Suenaga, M. (Division of Materials Science, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 16, 8798-8801(1 Dec 1987).

The role of H in superconducting H/sub x/$YBa_2Cu_3O_7$ ($0.14<x<5.0$) has been examined in infrared (ir) and x-ray absorption spectroscopy (XAS) measurements. The ir studies indicate the formation of Cu-H bonds and a hydride-phase precipitation. The XAS measurements of one of the samples, H/sub 1.0/$YBa_2Cu_3O_7$, show a partial reduction of the Cu/sup 2+/ state to the Cu/sup 1+/ state and deformation of both the Cu(1) and Cu(2) sites. The XAS results also confirm that H is located interstitially only near Cu sites.

15146 **Microwave observation of magnetic field penetration of high-T/sub c/ superconducting oxides.** Khachaturyan, K.; Weber, E.R.; Tejedor, P.; Stacy, A.M.; Portis, A.M. (Department of Materials Science and Mineral Engineering, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 16, 8309-8314(1 Dec 1987).

Microwave methods, using a conventional EPR spectrometer, have been applied to a study of magnetic field penetration of the high-T/sub c/ superconducting oxides La/sub 1.85/Sr/sub 0.15/CuO_4, $YBa_2Cu_3O_7$, and $EuBa_2Cu_3O_7$. Signals over 10^5 times the sensitivity limit of the EPR spectrometer were obtained. Huge low-field peaks were observed in the superconducting phase for magnetic fields below 10 G. The peak signal decreased exponentially with temperature just below T/sub c/. These observations are taken as evidence of the spin-glass features of these materials and of fluxoid penetration of intrinsic Josephson junctions.

15147 **Extended x-ray-absorption fine-structure study of La/sub 2-//sub x/Sr/sub x/CuO/sub 4-//sub y/ superconductors.** Tranquada, J.M.; Heald, S.M.; Moodenbaugh, A.R. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 16, 8401-8407(1 Dec 1987). Contract AC02-76CH00016.

From measurements of extended x-ray-absorption fine structure at the Cu K edge between 10 and 300 K, we have determined the temperature dependence of the mean-square relative displacements σ^2 for Cu-O, Cu-La, and Cu-Cu near neighbors in La/sub 2-//sub x/Sr/sub x/CuO/sub 4-//sub y/ with x = 0, 0.15, and 0.3. It is found that σ^2 for Cu-O and Cu-La neighbors shows little variation with x. Model calculations are used to demonstrate that σ/sub Cu-O/^{2} is sensitive to softening of the Cu-O breathing mode which has been predicted to be important for superconductivity in these materials. The Cu-O bonding is observed to be quite strong and no evidence is found for any significant change in the breathing-mode frequency with doping.

15148 **Anderson Hamiltonian description of the experimental electronic structure and magnetic interactions of copper oxide superconductors.** Shen, Z.; Allen, J.W.; Yeh, J.J.; Kang, J.; Ellis, W.; Spicer, W.; Lindau, I.; Maple, M.B.; Dalichaouch, Y.D.; Torikachvili, M.S.; and others. (Stanford Electronics Laboratory, Stanford, California 94305). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 16, 8414-8428(1 Dec 1987).

We describe valence-band and core-level photoemission data for copper oxide superconductors using the Anderson Hamiltonian applied to an impurity-cluster configuration-interaction model. We obtain experimental values of the parameters of the model the copper X oxygen charge transfer energy $\Delta \sim 0.4$ eV, the d-d Coulomb interaction $U \sim 6$ eV, and the ligand-d hybridization $T \sim 2.4$ eV. Using these parameters, we evaluate the linear Cu-O-Cu superexchange interaction J and find it is dominated by the charge-transfer fluctuations. The magnitude obtained for J is much larger than typical Neel temperatures of these materials, and is somewhat larger than that estimated from applying the resonating-valence-bond picture to La_2CuO_4. We point out that for $\Delta << U$, ant $T >> \Delta$, the charge-transfer degrees of freedom, and the lattice aspects of the Anderson lattice Hamiltonian, should not be neglected in constructing models for the high-T/sub c/ superconductivity. We also emphasize our resonant-photoemission result that the very small density of states at or near the Fermi level in all these materials has a substantial contribution from Cu 3d states, suggesting their importance for the superconductivity. We report other details of the resonant-photoemission data involving La and Ba states in the materials containing these elements.

15149 **Low-temperature thermal conductivity of YBa_2Cu_3O/sub 7-//sub δ/.** Freeman, J.J.; Friedmann, T.A.; Ginsberg, D.M.; Chen, J.; Zangvil, A. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 16, 8786-8787(1 Dec 1987). Contract AC02-76ER01198.

The thermal conductivity YBa_2Cu_3O/sub 7-//sub δ/ has been measured between 0.1 and 7 K. The data are similar in magnitude and temperature dependence to data for other sintered ceramics.

15150 **Magnetic ordering and magnetization in the high-temperature superconductor $ErBa_2Cu_3O$/sub 7-//sub x/.** Yang, H.D.; Ku, H.C.; Klavins, P.; Shelton, R.N. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 16, 8791-8793(1 Dec 1987).

Low-temperature heat-capacity, electrical resistivity, and magnetization measurements are performed to investigate the superconducting and magnetic behavior of $ErBa_2Cu_3O$/sub 7-//sub x/. This compound exhibits a superconducting transition at 84 K as determined from zero resistance and Meissner effect. A well-defined magnetic transition is seen at 0.87 K from heat-capacity measurements. We deduce the coexistence of superconductivity and antiferromagnetic order in this compound; however, magnetization data show that the paramagnetism from Er/sup 3+/ and superconductivity are independent, leading to indirect evidence of extremely anisotropic superconductivity in this class of compounds.

15151 **Temperature dependence of positron-annihilation parameters in YBa_2Cu_3O/sub 7-//sub x/ above and below the superconducting transition.** Usmar, S.G.; Sferlazzo, P.; Lynn, K.G.; Moodenbaugh, A.R. (Department of Applied Science, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 16, 8854-8857(1 Dec 1987).

The temperature dependence of positron-annihilation parameters for YBa_2Cu_3O/sub 7-//sub x/ x = 0.7, 0.4, and 0.0 are reported. It was found that a transition in the Doppler line-shape parameter S was associated with the superconducting transition temperature (T/sub c/) in YBa_2Cu_3O/sub 7-//sub x/ x = 0.4 and 0.0, while no transition was observed in the nonsuperconducting YBa_2Cu_3O/sub 6.3/. Positron lifetime parameters in $YBa_2Cu_3O_7$

were found to be consistent with positrons localized at open volume regions (probably unoccupied crystallographic sites) in this material with a lifetime of 210 psec. The positron lifetime decreased by approximately 5% across the superconducting transition and subsequently by 4% to 193 +-- 1 psec at 12 K. These results indicate that the electron density at this site increases approximately 9% between 100 and 12 K. Doppler line-shape results show that the average electron momentum at the annihilation site increases across the superconducting transition and from sample to sample as the oxygen concentration decreases.

15152 **Precautions when interpreting EPR and dc magnetization measurements of high-T/sub c/ RBa_2Cu_3O/sub y/-phase superconducting materials.** Vier, D.C.; Oseroff, S.B.; Salling, C.T.; Smyth, J.F.; Schultz, S.; Dalichaouch, Y.; Lee, B.W.; Maple, M.B.; Fisk, Z.; Thompson, J.D.; and others. (University of California, San Diego, La Jolla California 92093). *Physical Review [Section] B: Condensed Matter;* **36**: No. 16, 8888-8891(1 Dec 1987).

Many electron-paramagnetic-resonance (EPR) and magnetic susceptibility measurements for the high-T/sub c/ superconductors of the form RBa_2Cu_3O/sub 9-//sub x/ (R = Y or a rare earth) have been reported. Excluding local moment resonances due solely to the R atoms, we show that all of the EPR measurements known to us are not intrinsic to the superconducting phase, but rather are due to low concentrations of spurious phases typically present in the samples. $BaCuO_2$ is found to be the main source of the low-temperature EPR signal and of the magnetic susceptibility which has been reported for YBa_2Cu_3O/sub 9-//sub x/ above T/sub c/.

15153 **Probing electronic density of states and magnetic interactions at the rare-earth site in $ErBa_2Cu_3O_7$.** Walter, U.; Fahy, S.; Zettl, A.; Louie, S.G.; Cohen, M.L.; Tejedor, P.; Stacy, A.M. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **36**: No. 16, 8899-8902(1 Dec 1987).

By exploiting the 4f-shell properties of Er in the high-T/sub c/ superconductor $ErBa_2Cu_3O_7$, we find by inelastic magnetic neutron scattering that the electrostatic field around the rare-earth site is anomalously large. Above T/sub c/ there exists considerable magnetic interaction between the conduction electrons and the rare-earth's 4f shell: N(E/sub F/)J/sub ex/ = 0.025. This interaction is lost in the superconducting state. The ground-state magnetic moment of Er in the host lattice is μ/sub e//sub f//sub f/ = 5.3μ/sub B/. .AE

15154 **Magnetic isolation of Gd in superconducting $GdBa_2Cu_3O$/sub 7-//sub δ/.** Alp, E.E.; Soderholm, L.; Shenoy, G.K.; Hinks, D.G.; Capone II, D.W.; Zhang, K.; Dunlap, B.D. (Materials Science and Chemistry Divisions, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **36**: No. 16, 8910-8913(1 Dec 1987). Contract W-31-109-ENG-38.

The electronic and magnetic structures of Gd in superconducting $GdBa_2Cu_3O$/sub 7-//sub δ/ have been probed using the 86.5-keV Moessbauer resonance transition in /sup 155/Gd. The values of the hyperfine interaction parameters provide direct evidence for an absence of conduction electrons at the Gd site in this lattice and hence no exchange coupling of the Gd ion with the conduction electrons. The results explain why the superconducting transition temperature of YBa_2Cu_3O/sub 7-//sub δ/ is not suppressed by the substitution of Y atoms by magnetic Gd atoms.

15155 **Band electronic structure of the purple potassium molybdenum bronze K/sub 0.9/Mo_6O_{17}.** Whangbo, M.H.; Canadell, E.; Schlenker, C. (North Carolina State Univ., Raleigh). *Journal of the American Chemical Society;* **109**: No. 21, 6308-6313(14 Oct 1987). Contract FG05-86ER45259.

The electronic properties of potassium molybdenum purple bronze K/sub 0.9/Mo_6O_{17} were examined by performing tight-binding band calculations on a single Mo_6O_{17} layer. The authors calculations show the presence of three partially filled d-block bands, which are essentially derived from the t/sub 2g/ orbitals of the MoO_6 octahedra belonging to the innermost two sublayers of Mo_6O_{17}. The Fermi surfaces of the three partially filled bands are all closed, and thus K/sub 0.9/Mo_6O_{17} is a two-dimensional metal. The charge density wave of K/sub 0.9/Mo_6O_{17}, which sets in at 120 K, is caused by the nesting of one of the three Fermi surfaces, and the remaining two provide electron and the hole carriers below 120 K. The t/sub 2g/-block bands of the innermost two sublayers of Mo_6O_{17} were examined by analyzing the band orbitals at a few high-symmetry wave vector points. The dispersion characteristics of those bands are determined by whether or not the orbitals of bridging oxygen atoms can mix with the molybdenum t/sub 2g/ orbitals.

15156 **Theory of the orthorhombic-tetragonal phase transition in YBa/sub 2/Cu/sub 3/Osub(7-x).** Bakker, H.; Welch, D.O.; Lazareth, O.W. Jr. (Brookhaven National Lab., Upton, NY, USA). *Solid State Communications;* **64**: No. 2, 237-240(Oct 1987).

A theoretical open-system order-disorder model of the orthorhombic-tetragonal phase transition in YBa/sub 2/Cu/sub 3/Osub(7-x) is presented which gives good agreement with experimental data on the temperature dependence of the lattice parameters near the transition.

15157 **Oxygen ordering and superconductivity in La(Basub(2-x)Lasub(x))Cu/sub 3/Osub(7+δ).** Segre, C.U.; Zhang, K.; Dabrowski, B.; Hinks, D.G.; Jorgensen, J.D.; Beno, M.A.; Schuller, I.K. (Illinois Inst. of Tech., Chicago, USA. Dept. of Physics; Argonne National Lab., IL, USA). *Nature (London);* **329**: No. 6136, 227-229(17 Sep 1987).

In the present neutron powder diffraction study of a series of La(Basub(2-x)Lasub(x))Cu/sub 3/Osub(7+δ) compounds, the authors show that the superconducting phase is a similarly disordered isomorph of the orthorhombic YBa/sub 2/Cu/sub 3/Osub(7-δ) structure. The region of solid solubility for this compound extends from x = 0.5 (La:Ba:Cu ratios of 3:3:6) to x $\simeq$ 0.25 and does not include the stoichiometric compound x = 0 (LaBa/sub 2/Cu/sub 3/07sub(7-δ)). The presence of Cu-O chains, and not just a formal copper charge state of > 2, is vital for the occurrence of superconductivity.

15158 **Incorporation of Pr in YBa/sub 2/Cu/sub 3/Osub(7-delta): electronic effects on superconductivity.** Soderholm, L.; Hinks, D.G.; Beno, M.A.; Jorgensen, J.D.; Schuller, I.K.; Zhang, K.; Segre, C.U. (Argonne National Lab., IL, USA; Illinois Inst. of Tech., Chicago, USA). *Nature (London);* **328**: No. 6131, 604-605(13 Aug 1987).

The paper presents the results of a study of the structure and transport properties of the series of compounds Ysub(1-x)Prsub(x)Ba/sub 2/Cu/sub 3/Osub(7-δ) (x = 0-1.0). The authors observed a monotonic decrease in Tsub(c), and eventually a metal-insulator transition with increasing Pr concentration. To date, this is the only rare-earth ion which has been found substantially to alter Tsub(c) upon partial substitution for Y.

15159 **(ESA-TT—1031) Contributions to the investigation of mechanical behavior of gamma/gamma NbC Cotac composites at medium and at high temperature.** Damerval, C. (European Space Agency, 75 - Paris (France)). May 1987. Transl. into ENGLISH of Contributions a l'Etude du Comportement Mecanique des Composites Cotac Gamma/Gamma-NbC a Moyenne et Haute Temperature (Paris, France, ONERA), 1986. (ONERA-NT—1986-3; ETN—87-90869). 235p. NTIS, PC A11/MF A01.

The behavior of gamma/gamma' NbC Cotac fiber composites under creep, transverse tension, thermal cycling under stress, and low-cycle fatigue was studied. In creep, it is demonstrated that in Cotac 784 the transfer of load from matrix to fibers is accompanied by a change in the mechanism of plastic deformation of the matrix during a test. In transverse tensile loading, analysis of the failure mechanisms of Cotac 744 and 784 enables qualitative interpretation of their ductility evolution with temperature, in the light of the yield stress of the matrix, the cohesive stress of the grain boundaries, and the cleavage stress of the lamellae of NbC. Thermal cycling causes the creep lifetime of Cotac 744 and 784 to decrease by a factor of 3 at 1100 C. In low-cycle fatigue, Cotac 784 was characterized at 650 C in tension/compression strain-controlled loading.

15160 Effects of cation substitution on electrical and thermal transport properties of YCrO/sub 3/ and LaCrO/sub 3/. Weber, W.J.; Griffin, C.W.; Bates, J.L. (Battelle, Pacific Northwest Labs., Richland, WA 99352). *Journal of the American Ceramic Society;* 70: No. 4, 265-270(Apr 1987).

High-temperature electrical conductivity, Seebeck coefficient, and thermal conductivity measurements were used to study the effects of different cation substituents on electric and thermal transport in YCrO/sub 3/ and LaCrO/sub 3/. The substitution of divalent Ca and Sr for Y and La, respectively, resulted in the formation of small polarons as charged carriers. The additional substitution of Mn for Cr resulted in the formation of a second charge carrier associated with the Mn. The electrical conductivity results were consistent with thermally activated transport by hopping of a temperature-independent carrier concentration. The activation energies were 0.20 and 0.12 eV for (Y,Ca)CrO/sub 3/ and (La,Sr)CrO/sub 3/, respectively, and increased to about 0.50 eV with the substitution of Mn for Cr. The Seebeck coefficient increased linearly with temperature and decreased with substituent concentration for both (Y,Ca)CrO/sub 3/ and (La,Sr)CrO/sub 3/. The substitution of Mn for Cr resulted in a Seebeck coefficient with a more complex dependence on temperature and substituent concentration. The thermal conductivity did not change significantly with either cation substitution or temperature.

15161 Stabilization of the perovskite phase and dielectric properties of ceramics in the Pb(Zn/sub 1/3/Nb/sub 2/3/)O/sub 3/-BaTiO/sub 3/ system. Halliyal, A.; Kumar, U.; Newnham, R.E.; Cross, L.E. (Pennsylvania State Univ., Materials Research Lab., University Park, PA 16802). *American Ceramic Society Bulletin;* 66: No. 4, 671-676(1987).

The formation of a pyrochlore structure phase is a major problem in the preparation of Pb(Zn/sub 1/3/Nb/sub 2/3/)O/sub 3/ (PZN) based ceramics since its presence is detrimental to the dielectric and piezoelectric properties. An analysis of electronegativity difference and tolerance factor of several ABO/sub 3/ type of compounds shows that BaTiO/sub 3/ is an excellent additive to stabilize perovskite phase in PZN, and the present experiments show that 6 to 7 mol% of BaTiO/sub 3/ stabilizes perovskite structure in PZN. Phase relations, ceramic preparation procedure, and dielectric properties of compositions in the PZN-BT system are presented. Curie temperatures of the compositions in this system range between - 130° to 140°C. Compositions suitable for capacitor application have been identified.

15162 Crystal structure of $LaNi_5D_7$. Thompson, P.; Reilly, J.J.; Corliss, L.M.; Hastings, J.M.; Hempelmann, R. (Brookhaven National Lab., Upton, NY, USA; Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.). *Journal of Physics F (London). Metal Physics (London);* 16: No. 6, 675-685(Jun 1986).

The structure of β LaNi$_5$Dsub(x) was solved using neutron powder diffraction methods by making use of two specimens, one composed of normal Ni, the other of ^{60}Ni. The diffraction patterns showed the existence of a superlattice line which could be indexed if the hexagonal unit cell of the metal was doubled along the C axis. The structure was refined by the method of Rietveld in space group $P6_3$ mc with good agreement between the observed and calculated intensities. The deuterium was found to occupy three different sites; two tetrahedrally coordinated with Ni_4 and La_2Ni_2 neighbours and one octahedral site, La_2Ni_4.

15163 Chemical thermodynamic representation of very nonstoichiometric phases: <Ce0sub(2-x)>. Lindemer, T.B. (Oak Ridge National Lab., TN, USA). *CALPHAD: Computer Coupling of Phase Diagrams and Thermochemistry;* 10: No. 2, 129-136(Apr-Jun 1986). Contract AC05-84OR21400.

The entire <Ce0sub(2-x)> data base for the dependence of the nonstoichiometry, x, on temperature and chemical potential of oxygen (oxygen potential) was retrieved from the literature and represented by a thermodynamic method. The method resulted in partial molal Gibbs free energy quantities that are useful for any thermodynamic calculation involving <Ce0sub(2-x)>. It also accurately represents, for the first time, the complex behaviour of the experimental data, including the low-temperature miscibility gap. The method appears to be generally applicable to many very nonstoichiometric phases.

3606 Other Materials

REFER ALSO TO CITATION(S) 13970, 14242, 14256, 14288, 14379, 14410, 14411, 14416, 14421, 14427, 14428, 14428, 14429, 14430, 14430, 14432, 14433, 14434, 14436, 14440, 14440, 14441, 14441, 14443, 14444, 14444, 14526, 14709, 14937, 15005, 15025, 15038, 15049, 15057, 15079, 15081, 15116, 15487, 15572, 15592, 15594, 15596, 15597, 15647, 15658, 15665, 15665, 15671, 15890, 15899, 16176, 17332, 17350, 17391

15164 (AD-A—185549/3/XAB) Characterization of mechanical-damage mechanisms in ceramic-composite materials. Technical report, 24 May 1986-23 May 1987. Lankford, J. (Southwest Research Inst., San Antonio, TX (USA)). Aug 1987. 50p. (SWRI—06-8124). NTIS, PC A03/MF A01.

Earlier work on compressive strength of glass-ceramic matrix SiC fiber-reinforced composites is extended to define their behavior at high strain rates, and to assess the role of matrix phase versus fibers under such conditions. It is shown that the composite material can possess extremely high strain-rate-hardening exponents for strain rates in excess of about 400/s. These uniquely rapid increases in strength are found to depend upon composite microstructure and its orientation relative to the load axis; specifically, such strengthening correlates with at least one major set of fiber bundles being parallel to the load axis. The latter fail by kink initiation and propagation, a highly strain-rate-dependent, temperature-independent process. For off-axis implusive-load situations, the pyroceram matrix itself plays a significant role in controlling failure.

15165 (AD-A—185576/6/XAB) Native oxide encapsulation for annealing boron-implanted Hg(1-x)Cd(x)Te. Kao, T.M.; Sigmon, T.W. (Stanford Univ., CA (USA). Stanford Electronics Labs.). 25 Aug 1986. 4p. NTIS, PC A02/MF A01.

Pub. in Applied Physics Letter, Vol. 49, No. 8, 464-466(25 Aug 1986).

The use of Hg/sub 1-x/CdxTe(MCT) in infrared photovoltaic focal plane arrays would benefit considerably from a planar device fabrication process, such as is offered by ion implantation. Implantation would allow selective doping and eliminate the present mesa process used for these structures. However, the effect most often observed in implanted MCT is a radiation damage induced n electrical activity which results in junctions several times deeper than the atomic profile of the implanted impurity. This result causes difficulty in achieving precise control of the implanted junctions. Also, further heat treatments often used in processing are found to cause changes in the properties of this defect layer. In this work, we describe a native oxide encapsulation process capable of withstanding rapid thermal annealing (RTA) or long-time furnace annealing without Hg over pressure or loss from the substrate. We report for the first time electrical activation of implanted B along with implantation damage removal using this native oxide as an annealing encapsulant.

15166 (AERE-R—12081) Effects of gamma radiation on polymer matrix waste forms. Johnson, D.I.; Burnay, S.G.; Phillips, D.C. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.; Commission of the European Communities, Brussels (Belgium)). Jun 1986. 61p. (EUR—10413). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750875/JAW.

A study has been made of the volume and weight changes, mechanical properties, and radiolytic gas production of polymer matrix waste forms during γ irradiation in open containers. The work has been commissioned by the Department of the Environment as part of its radioactive waste management research programme. The materials included polyester, vinyl ester, epoxide and polystyrene resins containing ion exchangers; and polyester and epoxide resins containing a PWR evaporator concentrate.

15167 (AERE-R—12347) Alpha damage in non-reference waste form matrix materials. Burnay, S.G. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.; Department of the Environment, London (UK)). May 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750336/JAW.

Although bitumen is the matrix material currently used for European α-bearing intermediate level waste streams, polymer and polymer-modified cement matrices could have advantages over bitumen for such wastes. Two organic matrix systems have been studied - an epoxide resin, and an epoxide modified cement. Alpha irradiations were carried out by incorporating ^{241}Am at approx. 0.9 Ci/l. Comparisons have been made with unirradiated material and with materials which had been γ-irradiated to the same dose as the α-irradiated samples. Measurements were made of dimensional changes, mechanical properties and the leaching behaviour of ^{241}Am and ^{137}Cs. A limited amount of swelling (< 3%) was observed in α-irradiated epoxide resin; none was observed in the epoxide modified cement. Gamma irradiation to 300 kGy has no significant effect on the mechanical properties of either system. However, alpha irradiation to the same dose produced significant changes in flexural strength, an increase for the polymer and a decrease for the polymer-cement. Leaching in these systems was found to be a diffusion-controlled process; alpha irradiation to approx. 250 kGy has little effect on the leaching behaviour of either system.

15168 **(BNL—40532) Positron annihilation spectroscopy of AlGaAs/GaAs interfaces in MOCVD-grown GaAs heterojunction solar cells.** DeWald, A.B.; Frost, R.L.; Ringel, S.A.; Schaffer, J.P.; Rohatgi, A.; Nielsen, B.; Lynn, K.G. (Georgia Inst. of Tech., Atlanta (USA); Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 21p. (CONF-871125—17). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003903/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

The defect density profile of high efficiency epitaxial MOCVD-grown GaAs heterojunction solar cell structures has been characterized using a variable-energy positron beam. By control of the implantation depth of positrons, spatial defect changes, film thickness variations, and possibly interfacial space charge and disorder may be resolved from annihilation characteristics. Correlations have been made relating positron annihilation spectroscopy (PAS) measurements to SPV data, band bending, and known MOCVD growth parameter variations. 11 refs., 4 figs., 1 tab.

15169 **(CEA-CONF—9079) Radiation effects on phase separation and viscosity of glasses.** Biron, I.; Barbu, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Jun 1987. 7p. (CONF-8706151—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751551/JAW.

From 2. international conference on the effects of modes of formation on the structure of glasses; Nashville, TN, USA (16 Jun 1987).

The effect of electron irradiations on the stability of B/sub 2/O/sub 3P/bO glasses is studied by transmission electron microscopy. Rapid coagulation of pure lead particles is observed. By using the Smoluchosky's coagulation theory, it is shown that the viscosity of B/sub 2/O/sub 3/ is drastically reduced by several orders of magnitude under irradiation. The electron excitations are shown to play the dominant role in this phenomena.

15170 **(CEA-CONF—9107) Stability of B/sub 2/O/sub 3/-PbO glasses under irradiation.** Biron, I.; Barbu, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Jul 1987. 11p. (CONF-870783—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751559/JAW.

From Radiation effects in insulators-4 conference; Lyon, France (6 Jul 1987).

The stability of B/sub 2/O/sub 3/-PbO glasses under in situ electron irradiation have been investigated owing to a careful measurement of the local temperature rise of the sample under the beam. It is shown that, both inside and outside miscibility gap, droplets of pure lead feature Brownian Motion and coagulate at a rate depending on the electron flux and the temperature. The evolution of the density of particle have been measured and by using the coagulation theory of Smoluchowsky, the viscosity of the practically pur B/sub 2/O/sub 3/ matrix has been obtained: it is drastically reduced by up to 10 orders of magnitude by irradiation. It is shown and discussed that this effect come from electronic excitation but is much more important when atomic displacement are present.

15171 **(CEA-CONF—9108) Radiation effects in organic metals: a conductivity measurement of the damage in molecular crystals.** Bouffard, S.; Balanzat, E. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Jul 1987. 9p. (CONF-870783—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751560/JAW.

From Radiation effects in insulators-4 conference; Lyon, France (6 Jul 1987).

The organic metals are interesting systems for the irradiation of molecular compounds: they behave similarly, from the point of view of defect production, as conventional molecular crystals and their quasi-one dimensionality allows a direct determination, by electrical conductivity measurement, of the defect concentration. The irradiations with high energetic heavy ions/sup +/ show an increase of the damage production rate when the energy released by the ions in electronic excitation increases; this enhancement is interpretated as a reduction of the probability of deexcitation without defect production.

15172 **(CEA-CONF—9111) Electrical doping of Hg Cd Te by ion implantation and heat treatments.** Destefanis, G.L. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). Jul 1987. 81p. (CONF-870799—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751716/JAW.

From American conference on crystal growth; Monterey, CA, USA (13 Jul 1987).

The general properties of junctions made by ion implantation in Hg Cd Te semiconductor are recalled structure of junctions made by implantation damage, defects, anneals, junctions made by active impurities. The effect of acceptor evolution in this semiconductor after heat treatments and a study of the kinetics are presented. Very high quality devices with very small size and large two-dimensional arrays are shown to be possibly achieved using ion implantation technique of junction formation in the semiconductor epilayers grown by LPE.

15173 **(CEA-CONF—9120) First-order Kondo-frustrated antiferromagnetic ordering in the heavy electron compound YbAs.** Bonville, P.; Hodges, J.A.; Jehanno, G.; Hulliger, F.; Ott, H.R.; Marimon da Cunha, J.B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). Aug 1987. 5p. (CONF-870825—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751563/JAW.

From International conference on the applications of the Mossbauer effect; Melbourne, Australia (17 Aug 1987).

/sup 170/Yb Mossbauer measurements show that the heavy electron compound YbAs undergoes a first order paramagnetic-antiferromagnetic transition centered at T/sub N/ = 0.58K. The saturated 4f-shell magnetic moments are reduced by 47% relative to the value predicted by a crystal field model. A study of the line shapes below T/sub N/ in the presence of an external field shows that the RKKY exchange energy is about 20 times bigger than k/sub B/T/sub N/. These results show that YbAs presents a magnetic order frustrated by the Kondo effect.

15174 **(CONF-870783—7) An in-situ annealing study of lead implanted single crystal calcium titanate.** Rankin, J.; Hobbs, L.W.; Boatner, L.A.; White, C.W. (Oak Ridge National Lab., TN (USA); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Jul 1987. Contract AC05-84OR21400;FG02-84ER45090. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005435/JAW.

From Radiation effects in insulators-4 conference; Lyon, France (6 Jul 1987).

In-situ annealing studies have been carried out in ion-implanted single crystals of $CaTiO_3$. These crystals were implanted along both the a and b axes of this orthorhombic perovskite struc-

ture (Pcmn). Through the use of a VCR connected to a television system on a transmission electron microscope, the regrowth process was observed and the growth rate monitored. Samples were annealed in a single tilt hot stage at ~475°C. The near-surface region of this material, approximately 190 nm, is turned amorphous by the implantation of 540 KeV Pb ions at a fluence of $1(10^{15})/cm^2$. Annealing at 475°C results in the epitaxial regrowth of the damaged region. The regrowth process begins at the original amorphous/crystalline interface and proceeds outward to the surface. This phenomenon has been studied for implantations along both the <010> and the <100> crystallographic directions. For constant accelerating voltage and fluence of the implanted lead ions, transmission electron microscopy and Rutherford backscattering spectroscopy indicate that the regrowth rate is linear with time but strongly dependent on the oxygen partial pressure in the annealing atmosphere, and the implantation and subsequent regrowth direction.

15175 (CRN-CPR—87-01) Neutralization study of boron and some metallic impurities (gold, titanium, manganese, chromium) by hydrogen implantation in monocrystal silicon. Zundel, T. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Feb 1987. 118p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751372/JAW.

Boron doped silicon implanted with hydrogen at low energy in the temperature range 80-140/sup 0/C shows a large decrease of the electrically active dopant concentration up to a depth which increases with the temperature, the implantation duration and the starting material resistivity. This effect is assigned to the formation of an electrically inactive BH complex. The hydrogen incorporation process shows a weakly temperature dependent enhanced diffusion step followed by a normal diffusion phase which may be described by a thermally activated diffusion coefficient. Heating at 80/sup 0/C produces a complete dissociation of the BH complexes in the space charge region of reverse biased Schottky diodes. Consequently the released hydrogen drifts under the electric field and the neutralization becomes more pronounced in the bulk. Hydrogen neutralizes the gold, chromium, manganese related deep levels but has no effect on titanium related defect levels. Thermal annealing at 495/sup 0/C of hydrogenated chromium or manganese doped samples produces four majority carriers levels which disappear at 700/sup 0/C.

15176 (DOE/ER/12037—2) Mechanisms of wear in single- and two-phase materials: Final report. Macmillan, N.H. (Pennsylvania State Univ., University Park (USA). Materials Research Lab.). Nov 1987. Contract AC02-82ER12037. 224p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88003846/JAW.

A comparative study has been made of the rolling-tumbling-sliding wear and solid particle erosion behavior of four single-phase materials (Cu, Pb, Al_2O_3, and a lead borosilicate glass and of series of ductile-ductile (Pb-Cu), ductile-brittle (Pb-Al_2O_3), brittle-ductile (glass-Cu), and brittle-brittle (glass-Al_2O_3) composites prepared from them. The same irregularly shaped 600 μm WC-8 wt.% Co abrasive particles were used throughout this work. Additional erosion measurements have been made on Danto Koruntz, Abresist, and sintered α-SiC, using similar particles. Some subtle influences of erosive particle wear are documented for the first time, and the inadequacy of the currently available theoretical models to describe the influence of microstructure on erosion is exposed. 77 refs., 154 figs.

15177 (DOE/ER/45258—T1) The role of point defects on structural phase transitions: Progress report for the year 1987-1988. Toulouse, J. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Physics). 14 Jan 1988. Contract FG02-86ER45258. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005209/JAW.

Following the exploratory work of the first year of this project, the second year has seen firm progress in the understanding of the two primary systems studied, KTa/sub 1-x/Nb/sub x/O_3 and $KMnF_3$:Li. We have also devoted some time to the refinement of our ultrasonic capabilities and have in fact developed a new technique for the measurement of absolute sound velocity. Finally we have put together a Raman set up which is now close to being operative.

15178 (INIS-BR—748, pp 33) Electronic and location properties of trans-polyacetylene with distribution of soliton type defects. Melo, C.A.R.S. de; Koiller, B.; Brandi, H.S. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15179 (INIS-BR—748, pp 33) Correlation effects in the study of solitons in polyacetylene. Santos, M.C. dos; Melo, C.P. de. (Pernambuco Univ., Recife, Brazil; Pernambuco Univ., Recife, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15180 (INIS-BR—748, pp 34) Electrons bounded to the liquid helium surface in the presence of laser field. Lobo, R.; Hipolito, O. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15181 (INIS-BR—748, pp 77) Phase transitions of deuterium adsorbed in Grafoil. Chaves, F.A.B.; Cortez, M.E.B.P. (Rio de Janeiro Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15182 (INIS-BR—748, pp 77) Molecule dynamic of adsorbed electrons in the helium film on a substrate. Antonio, G.A.; Hipolito, O. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15183 (INIS-BR—748, pp 103) Deuterium NMR of new inductors of collestericity. Alcantara, M.R.; Vanin, J.A. (Universidade Estadual de Campinas, Brazil; Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15184 (INIS-BR—748, pp 103) NMR and optical properties of lyomesophase collesterics type II. Alcantara, M.R.; Vanin, J.A. (Universidade Estadual de Campinas, Brazil; Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15185 (INIS-BR—748, pp 61) Study of phase transitions in $LINH_4SO_4$. Martins, A.R.M.; Mendes Filho, J.; Melo, F.E.A.; Moreira, J.E.C.; Germano, F.A. (Ceara Univ., Fortaleza, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15186 (INIS-BR—748, pp 64) **Numerical and hydrodynamic simulation of Czochralski configuration.** Donadel, A.R.; Scalvi, L.V.A.; Mokross, B.J. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15187 (INIS-BR—748, pp 176) **Study of semiconductor alloys under pressure.** Lemos, V.; Motisuke, P.; Moro, J.R. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15188 (INIS-BR—748, pp 31) **Transition intensities in $YAlO_3:Pr^{3+}$.** Gouveia, E.A.; Sa, G.F. de; Malta, O.L. (Alagoas Univ., Maceio, Brazil; Pernambuco Univ., Recife, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15189 (INIS-BR—748, pp 34) **Properties of the optical absorption of organic semiconductors.** Rosa, A.L.S. da; Melo, C.P. de. (Pernambuco Univ., Recife, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15190 (INIS-BR—748, pp 35) **Correction of self-interaction in the approximation of functional density: MS-Xα.** Figueiredo, S.K. de; Fazzio, A. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15191 (INIS-BR—748, pp 37) **Spin diffusion in polyacetylene.** Correia, N. (Brasilia Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15192 (INIS-BR—748, pp 51) **Study of magnetite by neutron multiple diffraction.** Mazzocchi, V.L.; Parente, C.B.R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15193 (INIS-BR—748, pp 52) **X-ray topography of double crystal: study of natural and synthetic quartz.** Suzuki, C.K.; Farias, C.R.L.; Iwasaki, F.; Iwasaki, H. (Universidade Estadual de Campinas, Brazil; Japan International Cooperation Agency). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15194 (INIS-BR—748, pp 52) **Study of water sorption mechanisms in biopolymers.** Labaki, L.C.; Torrianni, I.L. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15195 (INIS-BR—748, pp 52) **Study of fractal surfaces by small angle X-ray scattering.** Craievich, A.F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15196 (INIS-BR—748, pp 53) **Study of the crotoxin complex by SAXS.** Beltran, J.R.; Mascarenhas, Y.P.; Craievich, A.F.; Laure, J. (Sao Paulo Univ., Sao Carlos, SP, Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Sao Paulo Univ., Ribeirao Preto, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15197 (INIS-BR—748, pp 53) **Study of SAXS and mycellas in solution.** Itri, R.; Amaral, L.Q. do. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15198 (INIS-BR—748, pp 54) **Study and characterization of Brazilian emerald from Santa Terezinha de Goias, Brazil.** Lariucci, C.; Santos, R.H.A.; Leite, C.R. (Goias Univ., Goiania, Brazil; Sao Paulo Univ., Sao Carlos, SP, Brazil; UNESP, Araraquara, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15199 (INIS-BR—748, pp 63) **Thermoluminescent properties of some acrylic resins.** Duran, J.E.R.; Vinha, D.; Panzeri, H. (8950064BR; Sao Paulo Univ., Ribeirao Preto, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15200 (INIS-BR—748, pp 65) **Application of synchrotron radiation to anomalous dispersion of X-rays for distinguishing Brazilian type geminates in amethyst.** Baran, Z. (Bahia Univ., Salvador, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15201 (INIS-BR—748, pp 66) **Characterization of quartz slices.** Suzuki, C.K.; Hummel, D.C.A.; Shinohara, A.H.; Oliveira, V.A.R.; Torikai, D.; Iwasaki, I.; Iwasaki, F. (Universidade Estadual de Campinas, Brazil; Japan International Cooperation Agency). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15202 (INIS-BR—748, pp 66) **Sn diffusion in GaAs:Cr using SiO_2:Sn source.** Almeida Santos, T.E. de; Carvalho, M.M.G. de. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15203 (INIS-BR—748, pp 67) **Study of oxygen precipitation kinetics in Si:B monocrystals by X-ray techniques.** Bulla, D.A.P.; Castro Junior, W.E. de; Stojanoff, V.; Pimentel, C.A.F.; Hahn, S. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15204 (INIS-BR—748, pp 67) **Determination of the stages of intercalar graphite compounds.** Bernussi, A.A.; Silva, M.P. da; Gualberto, G.M. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15205 (INIS-BR—748, pp 68) **Study of synthesis, crystallinity and properties of lamellar materials derived from zirconium phosphate (IV).** Alves, O.L. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15206 (INIS-BR—748, pp 68) **Growth and characterization of semiconductor materials for photoelectrochemical cells.** Cerdeira, F.; Torrianni, I.L.; Lemos, V.; Motisuke, P.; Decker, F. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15207 (INIS-BR—748, pp 68) **Growth of GaAs monocrystal by Bridgman method.** Carvalho, M.M.G. de; Oliveira, C.E.M. de. 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15208 (INIS-BR—748, pp 87) **Effects of location in multivalley semiconductors with superconducting transitions.** Silveira, H.V. da; Cerdeira, H.A. (Sao Carlos Univ., Brazil; Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15209 (INIS-BR—748, pp 88) **Chaos in Josephson junctions.** Octavio, M. (Instituto Venezolano de Investigaciones Cientificas, Caracas, Venezuela). 1986. (In Spanish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15210 (INIS-BR—748, pp 101) **Determination of crystal structures and calculations of directional diamagnetic susceptibility of decyl and dodecyl ammonium chloride.** Pinto, A.V.; Vencato, I.; Olmedo, H.G.; Mascarenhas, Y.P. (Santa Catarina Univ., Florianopolis, Brazil; Sao Paulo Univ., Sao Carlos, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15211 (INIS-BR—748, pp 104) **Study of benzenesulfonate ion in lyotropic mesophases and miscelar solutions.** Fujiwara, F.Y.; Custodio, A.R. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15212 (INIS-BR—748, pp 112) **Magnetization of Cu-L-Alanine$_2$ at very low temperature.** Calvo, R.; Novak, M.A.; Oseroff, S.; Symko, O.G. (Rio de Janeiro Univ., Brazil; San Diego State Univ., CA; Utah Univ., Salt Lake City). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15213 (INIS-BR—748, pp 113) **Phase diagram of the $NI(BrO_3)_2.6H_2O$ antiferromagnet.** Bindilatti, V.; Oliveira Junior, N.F.; Puech, L. (Sao Paulo Univ., Brazil; Centre National de la Recherche Scientifique, 38-Grenoble, France). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

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15214 (INIS-BR—748, pp 113) **Magnetization and magnetic susceptibility in Fe/sub 0.69/Zn/sub 0.31/ F_2 diluted antiferromagnet submitted to strong magnetic fields.** Montenegro, F.C.; Rezende, S.M. (Pernambuco Univ., Recife, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

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15215 (INIS-BR—748, pp 114) **Experimental study of low-dimensional magnetic systems.** Domingues, P.H.; Maria Neto, J. (Rio de Janeiro Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15216 (INIS-BR—748, pp 121) **Study of the oxidated ludlamite.** Moreira, L.F.; Amorim, H.S. de; Mattievich, E. (Rio de Janeiro Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

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15217 (INIS-BR—748, pp 122) **Transport phenomena in interpolated graphite compounds.** Silva, M.P. da; Bernussi, A.A.; Santos, C.; Gualberto, G.M. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15218 (INIS-BR—748, pp 127) **Quasi-particle energy of 4f states in rase earth systems: process pf weak correlation.** Troper, A.; Cunha Lima, I.C. da. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15219 (INIS-BR—748, pp 146) **Phase conjugation and measurement of nonlinear refraction index in Cr^{+3} and Nd^{+3} doped crystals.** Catunda, T.; Ruvolo Junior, E.C.; Castro, J.C. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15220 (INIS-BR—748, pp 147) **Excitation by two photons of 4f5D do Pr^{3+} band and interconfigurational transfer energy in La F_3 : (Pr^{3+}, Gd^{3+}).** Lizama, A.; Araujo, C.B. de. (Pernambuco Univ., Recife, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15221 (INIS-BR—748, pp 150) **Electrodeposition of CdSe semiconductor films on conductor glass.** Planas, S.A.; Moro, J.R.; Decker, F. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15222 (INIS-BR—748, pp 165) **Dependence of nuclear spin-lattice relaxation time with sublattices, temperature and applied magnetic field for ^{54}Mn in $MnCl_2$ $4H_2O$.** Araujo, M.A.B. de; Stone, N.J. (Ceara Univ., Fortaleza, Brazil; Clarendon Laboratory, Oxford, England). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15223 (INIS-BR—748, pp 166) **Nuclear spin-lattice relaxation of the randomly diluted antiferromagnets Mn/sub x/ Zn/sub 1-x/ F_2 and Fe/sub x/ Zn/sub 1-x/ F_2.** Magon, C.J.; Jaccarino, V.; King, A.R.; Yasuoka, H.; Alcaraz, F.C. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15224 (INIS-BR—748, pp 166) **NMR line widths in D=3 random field Ising systems: Fe/sub x/ Zn/sub 1-x/ F_2.** Magon, C.J.; Sartorelli, J.; King, A.R.; Jaccarino, V.; Itoh, M.; Yasuoka, H.; Heller, P. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15225 (INIS-BR—748, pp 169) **Detection of transformations produced by heating in amorphous iron (III) hydroxoacetate.** Silva, E.C. da; Iacovacci, M.; Vargas, H.; Pinheiro, E.A.; Galembeck, F. 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15226 (INIS-BR—748, pp 170) **Study of oxided ludlamite.** Moreira, L.F.; Amorim, H.S. de; Mattievich, E. (Rio de Janeiro Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15227 (INIS-BR—748, pp 171) **NMR line forms in the KNi/sub x/Mg/sub 1-x/F_3 diluted randomly magnetic system.** Franco Junior, A.; Engelsberg, M. (Pernambuco Univ., Recife, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15228 (INIS-BR—748, pp 178) **Impurities and conduction bands in doped semiconductors.** Perondi, L.F. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15229 (INIS-BR—748, pp 179) **Impurities of 5d transition metals in semiconductors.** Caldas, M.J.; Makiuchi, N.; Fazzio, A. (Universidade Estadual de Campinas, Brazil; Brasilia Univ., Brazil; Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15230 (INIS-BR—748, pp 179) **Diffusion mechanisms in semiconductors.** Silva, E.C.F.; Santos, M.D.F.M.; Leite, J.R.; Pino Junior, A.D. (Sao Paulo Univ., Brazil; Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15231 (INIS-BR—748, pp 180) **Transport properties of Cd/sub x/Mn/sub 1-x/Se (for x= 0,01;0,05;0,10) and carrier concentration at surroundings of metal-insulating transition.** Oliveira Junior, N.F.; Shapira, Y. (Sao Paulo Univ., Brazil; Massachusetts Institute of Technology, Cambridge). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15232 (INIS-BR—748, pp 180) **Effect of magnetic fields parallel to quantum well on valence and conduction bands in hetero-structures of GaAs-AlGaAs.** Oliveira, G.M.G. de; Gomes, V.M.S.; Leite, J.R.; Chaves, A.S.; Worloch, J.M. (Sao Paulo Univ., Brazil; Minas Gerais Univ., Belo Horizonte, Brazil; Bell Communications Research). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15233 (INIS-BR—748, pp 181) **Selfconsistent calculations of two-dimensional electron density in super-lattices with doping.** Gomes, V.M.S.; Leite, J.R.; Chaves, A.S.; Worlock, J.M. (Sao Paulo Univ., Brazil; Minas Gerais Univ., Belo Horizonte, Brazil; Bell Communications Research). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15234 (INIS-BR—748, pp 182) **Bound polaron in GaAs-GaAlAs quantum wells.** Degani, M.H.; Hipolito, O. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15235 (INIS-BR—748, pp 182) **Resonant polarons in GaAs-GaAlAs heterostructure.** Degani, M.H.; Hipolito, O. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15236 (INIS-BR—748, pp 184) **Systems of vacuum epitaxial growth by organometallic vapor deposition.** Carvalho, M.M.G. de; Barreto, C.L.; Ito, K.M. 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15237 (INIS-BR—748, pp 186) **Studies of oxygen accumulation in palladium silicide formed at Pd/a-Si interface.** Achete, C.A. (Rio de Janeiro Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15238 (INIS-BR—748, pp 189) **Multiphonons in GaAs : O hole photoexcitation.** Machado, W.V. 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15239 (INIS-BR—748, pp 190) **Photoluminescence in compounds III-V.** Furtado, M.F. (TELEBRAS, Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15240 (INIS-BR—748, pp 191) **Preliminary results of a qualification test for LED and lateral emission GaAlAs-GaAs.** Pereira, J.S.; Amaral Neto, R. do; Barbosa, F.R. (TELEBRAS, Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15241 (INIS-BR—748, pp 192) **Photoluminescence in GaAlAs epitaxial layers doped with Sn at low temperatures.** Montesinos, H.R.; Weid, J.P. von der; Furtado, M.T. 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15242 (INIS-BR—748, pp 192) **Transition metals in the interstice of III-V materials.** Scolfaro, L.M.R.; Fazzio, A. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15243 (INIS-BR—748, pp 192) **Correlation of crystal defects in the InP/InGaAsP interface by cathodoluminescence (CL).** Martins, R.B.; Ribeiro, C.A. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15244 (INIS-BR—748, pp 193) **Multiplet and relativistic effects on electronic structure of 4d/sup n/ impurities in GaP.** Macedo, T.C.A.; Fazzio, A. (UNESP, Guaratingueta, Brazil; Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15245 (INIS-BR—748, pp 193) **Electronic structure of copper, silver, gold and metallic vacance substitutional impurities in ZnSe, ZnTe and CdTe.** Chacham, H.; Alves, J.L.A.; Siqueira, M.L. de. (Minas Gerais Univ., Belo Horizonte, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15246 (INIS-BR—748, pp 194) **Electronic properties of substitutional gold complexes-interstitial transition metal in silicon.** Assali, L.V.C.; Leite, J.R. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15247 (INIS-BR—748, pp 181) **Electron correlations in semiconductor quantum wells.** Freitas, U. de; Almeida Caparica, A. de; Studart Filho, N. (Sao Paulo Univ., Sao Carlos, SP, Brazil; Sao Carlos Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15248 (INIS-BR—748, pp 64) **Lasing of F_2 centers in LiF:MG.** Udo, P.T.; Vieira Junior, N.D.; Rossi, W. de; Morato, S.P. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15249 (INIS-BR—748, pp 66) **Implatation of Sb by recoil in silicon by bombardment with germanium ions.** Erichsen Junior, R.; Hasenack, C.M.; Souza, J.P. de; Baumvol, I.J.R. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15250 (INIS-BR—748, pp 67) **Residual defects in silicon implanted with Ga, In, As, Sb, Ge, Sn and Pb ions submitted to fast thermal annealing.** Hasenack, C.M.; Souza, J.P. de; Baumvol, I.J.R. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15251 (INIS-BR—748, pp 122) **Range and diffusion of Bi ions implanted in polymers.** Guimaraes, R.B.; Amaral, L.; Behar, M.R.; Souza, J.P. de; Zawislak, F.C. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15252 (INIS-BR—748, pp 168) **Study of palladium paramagnetic complexes in NaCl and KCl doped with $Pd(CN)^{2-}_4$.** Grillo, M.L.N.; Vugman, N.V. (Rio de Janeiro Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15253 (INIS-BR—748, pp 170) **Electron paramagnetic resonance of atomic hydrogen centers in the Brazilian Rose tourmaline.** Camargo, M.B.; Pontuschka, W.M. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15254 (INIS-BR—748, pp 193) **Analysis of silicon implanted with $^{119}Sn^{+}$ by CEMS and channeling.** Scherer, E.M.; Hasenack, C.M.; Souza, J.P. de; Baumvol, I.J.R. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15256 (INIS-BR—748, pp 56) **Study of silicon chemical polishing for fabricating X-ray optical apparatus.** Rodrigues, A.R.D.; Mazzaro, I. (Sao Paulo Univ., Sao Carlos, SP, Brazil; Parana Univ., Curitiba, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15256 (INIS-BR—748, pp 186) **Preparation and characterization of CdS and CdSe thin films.** Juliao, J.F. (Ceara Univ., Fortaleza, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15257 (INIS-BR—748, pp 186) **Conductivity of the mineral molybdenite and its bonding and formation of ohmic contacts on metallic substrates.** Cesar, H.L. (Ceara Univ., Fortaleza, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15258 (INIS-BR—748, pp 188) **Fabrication of PbSnTe photovoltaic detectors using epitaxial techniques from liquid phases.** Ferreira, S.O.; Abramof, E.; Silva, M.D. da; Bandeira, I.N. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15259 (INIS-BR—748, pp 91) **$CaSO_4$: Dy + teflon sintered pellets for personnel and environmental monitoring.** Campos, L.L. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15260 (INIS-BR—748, pp 168) **Study of β and γ radiation induced defects in natural calcites by EPR: implicatons in dating by EPR.** (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15261 (INIS-mf—10786) **Buildings exposed to fire.** (Technische Univ. Braunschweig (Germany, F.R.). Sonderforschungsbereich Brandverhalten von Bauteilen). 1987. 214p. (In German and English). (CONF-8703223—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88751516/JAW.

From Final colloquium on buildings exposed to fire; Braunschweig, F.R. Germany (19 Mar 1987).

The 24 lectures presented to the colloquium cover the following subject fields: (1) Behaviour of structural components exposed to fire; (2) Behaviour of building materials exposed to fire; (3) Thermal processes; (4) Safety related, theoretical studies.

15262 (JAERI-M—87-141) **Data on radiation resistance of lubricating oil.** Arakawa, Kazuo; Morishita, Norio; Hayakawa, Naohiro; Machi, Sueo; Nakanishi, Hiroshi; Soda, Takao; Yagi, Tetsuya. (Japan Atomic Energy Research Inst., Tokyo). Sep 1987. 256p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88751978/JAW.

This report presents data of radiation resistance of commercial lubricating oils. Data included are the radiation induced change of properties such as kinematic viscosity, total acid number, flash point, pour point, specific gravity and color, and the results by instrumental analysis such as gas analysis by gas chromatography, ESR spectra, infrared spectra, mass spectra, and molecular weight distribution by liquid chromatography. Twenty-seven different kinds of commercial lubricating oils including mineral oils, a synthetic hydrocarbon oil, ester lubricants, a polyether, silicone oils, florinated oils and aromatic oils were irradiated with /sup 60/Co γ-rays at room temperature in a vacuum, in air and under bubbling oxygen. The irradiation was carried out up to 30 MGy at a dose rate of 10 kGy/h.

15263 (JAERI-M—87-155) **Effect of aromatic compounds on radiation resistance of polymers studied by optical emission.** Kawanishi, Shunichi; Hagiwara, Miyuki. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 26p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751984/JAW.

To clarify the effects of condensed bromoacenaphthylene (con-BACN) as a newly developed flame retardant on the radiation resistance of ethylene-propylene-diene-terpolymer (EPDM), optical emission behavior of aromatic compounds, acenaphthylene and acenaphthene as model compound of con-BACN was studied. The energy absorbed in polymer matrix is transferred to the aromatic molecules very fast within 1 ns, and introduces excited states of aromatic compound. The fluorescence from naphthalene units of the additives with peak at 337 and 350 nm (named AT emission band) was observed in EPDM containing acenaphthene or acenaphthylene. When aromatic peroxide was used as a crosslinking agent, another emission band (Xn band) was observed at 400 nm. It was found that these emission bands play a role in trapping sites in which a part of radiation energy release in the form of fluorescence. The energy level of the excited state was correlated to the radiation stability measured with coloration and oxidation reaction of the polymer. Furthermore, acenaphthylene having a reactive vinyl bond forms excimer emission band Ex whose level is lower than those of AT and Xn bands, and therefore, enhances radiation stability of matrix polymer by giving effective routes for energy release.

15264 (LA—11104-MS) **SESAME equation of state number 7100, dry sand.** Barnes, J.F.; Lyon, S.P. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005090/JAW.

A global equation of state (EOS) for a dry sand mixture at a grain density of 2.60 g/cm³ has been constructed and placed on the SESAME library as material number 7100. A "sandstone" EOS can be generated by combining the present EOS with a suitable EOS for water in the desired proportions. The hydrocode setup should then allow for the desired degree of porosity.

15265 (LA-SUB—H2050E-1) Short fiber reinforced thermoplastic composites for armor applications: Interfacial bonding: Preliminary final report, June 1, 1987-November 1, 1987. Day, D.E.; Rahaman, M.N. (Missouri Univ., Rolla (USA)). 20 Nov 1987. Contract W-7405-ENG-36. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004007/JAW.

The interfacial bond strength between high strength glass fibers and poly(methyl methacrylate) was measured by incorporating individual, continuous fibers in tensile samples of the polymer. When the fibers were coated with a silane coupling agent, the measured bond strength (20 MPa) was twice the value (10 MPa) obtained for the samples without coupling agent. Bonding between the same fibers and polycarbonate was examined using scanning electron microscopy. Fibers coated with an amino-silane coupling agent showed considerably better bonding to the polymer compared with the uncoated fibers. Work in progress involves optimization of the bonding in polycarbonate, and an examination of the bonding between the same fibers and polyacetal. 4 figs., 2 tabs.

15266 (LA-UR—87-4002) A chemical precursor to optical damage? Studies by laser ionization mass spectrometry. Nogar, N.S.; Estler, R.C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 10p. (CONF-8710165—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004321/JAW.

From Boulder damage symposium; Boulder, CO, USA (26 Oct 1987).

Mass spectrometry has been used in conjunction with Nomarski microscopy to characterize the initiation of optical damage in selected commercial optics. For a sample with an Al_2O_3/SiO_2 multilayer coating (351 nm) on a Si substrate, our results suggest layer by layer removal of the coating material with low-fluence irradiation at 1.06 mu. In addition, carbon impurities were observed in the low-damage threshold sample. For the Sc_2O_3/SiO_2 multilayer coated (351 nm) 7940 substrates, transient iron signals were observed at each increasing fluence level, with concomitant appearance of small circular (10 mu) pits in the surface. These pits were also associated with macroscopic damage features due to threshold testing.

15267 (LBL—22698) Structural characterization of undoped and doped GaAs: A comparative study of four techniques. Bourret, E.D.; Elliot, A.G.; Lee, B.T.; Jaklevic, J.M. (Lawrence Berkeley Lab., CA (USA); Hewlett-Packard Corp., San Jose, CA (USA). Optoelectronics Div.). Jun 1987. Contract AC03-76SF00098. 15p. (CONF-8704248—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004552/JAW.

From International symposium on defect recognition and image processing in III-V compounds (DRIP II); Monterey, CA, USA (27 Apr 1987).

Dislocations, striations and microprecipitates have been imaged in undoped and doped GaAs single crystals using four different techniques: chemical photoetching, synchrotron radiation topography, photoluminescence microscopy and electron microscopy. A comparison of the features observed by these techniques is presented. Photoetching was found to be the most sensitive technique to reveal electrically active structural defects specifically in cases where these defects do not produce significant lattice strain or do not act as recombination centers. 23 refs., 11 figs., 24 tabs.

15268 (LBL—22751) Spatial distribution of carbon and native defects in large-diameter bulk grown GaAs. Walukiewicz, W.; Bourret, E.; Yau, W.F.; Mc Murray, R.E. Jr.; Haller, E.E.; Bliss, D. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 9p. (CONF-8704248—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003870/JAW.

From International symposium on defect recognition and image processing in III-V compounds (DRIP II); Monterey, CA, USA (27 Apr 1987).

Different spectroscopic techniques have been combined to measure concentrations of carbon on arsenic sites and of neutral EL2. Utilizing the recently found dependence of the high resolution local vibrational mode spectrum on the charge state of the carbon acceptors we have been able to separately determine concentrations of neutral and ionized carbon after EL2 has been optically quenched. The concentration of ionized carbon shows a very distinct W-shaped variation across the wafer whereas the total carbon concentration is close to constant. The variations are caused by the nonuniform distribution of donors which are shallower than EL2. The account for the commonly observed variations of the near infrared absorption. Radiotracer experiments with GaAs crystals intentionally doped with ^{14}C showed that carbon is very homogeneously distributed in GaAs grown by horizontal Bridgman method. No correlation between the distribution of carbon and dislocations has been found. 17 refs., 5 figs.

15269 (LBL—22901) Silicon and indium doping of GaAs: Measurements of the effect of doping on mechanical behavior and relation with dislocation formation. Bourret, E.D.; Tabache, M.G.; Elliot, A.G.; Beeman, J.W.; Scott, M. (Lawrence Berkeley Lab., CA (USA); Hewlett-Packard Corp., San Jose, CA (USA). Optoelectronics Div.; Hewlett-Packard Corp., Palo Alto, CA (USA). Central Research Lab.). Jun 1987. Contract AC03-76SF00098. 23p. (CONF-870799—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003862/JAW.

From American conference on crystal growth; Monterey, CA, USA (13 Jul 1987).

The effect of indium and silicon doping on dislocation formation in GaAs single crystals has been studied experimentally using dynamic compression tests and indentation rosettes. By direct measurements of the critical resolved shear stress (CRSS) in temperature range from 400 to 1100°C using dynamic compression tests, we found that the critical resolved shear stress of GaAs:In is twice that of undoped GaAs. More recent measurements show that the critical resolved shear stress of silicon-doped crystals is lower than that of undoped GaAs. Well-defined indentation rosettes were obtained at high temperatures from a Vickers indenter using small loads. Analysis confirm that the mechanical behavior of the GaAs crystals is not drastically affected by the presence of dopants. Reduction of dislocation densities in doped crystals is attributed to modifications introduced by the dopant in the equilibrium concentration of native defects at the melting point (particularly gallium and arsenic vacancies). 22 refs., 5 figs., 3 tabs.

15270 (LBL—24166) Grazing incidence x-ray scattering study of defect structures in MBE GaAs/Si using synchrotron radiation. Laderman, S.S.; Kortright, J.; Scott, M.; Fischer-Colbrie, A. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 7p. (CONF-8704252—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004556/JAW.

From Heteroepitaxy on silicon technology conference; Anaheim, CA, USA (21 Apr 1987).

Defect structures in thin, MBE grown, GaAs/Si(001) heteroepitaxial films were studied with grazing incidence x-ray scattering techniques. The diffuse scattering associated with GaAs having the predominant epitaxial orientation varied strongly with the penetration depth of the x-rays. Well-directed streaks corresponding to planar faults were observed and easily distinguished from a broad and more randomly oriented background. Bragg peaks corresponding to twinned GaAs were also studied. The probability of twinning was seen to be much higher about the [111] planes whose normals, when projected onto the sample surface, lay parallel to the off-orientation direction than about the [111] planes whose normals, when projected onto the sample surface, lay perpendicular to the off-orientation direction. The intensity and breadth of the twin reflections were analyzed to estimate the corresponding defect density. The depth dependence of the twinning probability was seen to vary with growth parameters. 9 refs., 6 figs.

15271 (LYCEN-T—8643) Contribution to /sup 57/Fe ion implanted garnet study by Moessbauer effect. Kornilios, N. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Nov 1986. 149p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751764/JAW.

Due to because of their numerous physical properties, garnets are often used in new technologies. In order to improve their properties, ion implantation of inert gases has been proved to be a powerful technique to elaborate bubble memories. Recently it has been shown that high doses implanted ions, chemically reacting with the matrix could give interesting results. If the bulk is completely amorphized after implantation, further annealings can recrystallize it. In this study Y/sub 3/F/sub 5/O/sub 12/, Y/sub 3/Al/sub 5/O/sub 12/ and Gd/sub 3/Ga/sub 5/O/sub 12/ single crystals were 100 keV implanted with /sup 57/Fe ions at doses ranging between 10/sup 16/ and 10/sup 17/ ions cm/sup -2/. The iron chemical states were determined thanks to Conversion Electron Moessbauer Spectroscopy (CEMS) and it was shown that the alloying elements of the matrix could influence the nature of the created phases. After thermal treatments the sample superficial layers were characterized using CEMS, grazing angle X-ray Diffraction (XRD), Transmission Electron Microscopy (TEM) and Rutherford Backscattering Spectroscopy (RBS). Different annealing stages were put forward: the oxidation of the implanted iron below 650/sup 0/C and the garnet recrystallization around 850/sup 0/C with some iron substitution in the garnet octahedral and tetraedral sites. The overstoechiometric iron forms particles of mixed oxides (FeAl)/sub 2/O/sub 3/, (FeGa)/sub 2/O/sub /3 or particles of pure Fe/sub 2/O/sub 3/ oxide depending on the garnet. For the first time it is proved that after annealing around 1200-1300/sup 0/C a complete rebuilding of the garnet matrix can induce for these oxide particles at room temperature a Morin transition.

15272 (MLM—3475(OP)) Properties of seals made with Li_2O-Al_2O_3-SiO_2-glass ceramics and aluminum-containing austenitic stainless steels. Cassidy, R.T.; Fagin, P.N. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 6p. (CONF-871234—11). NTIS, PC A02. Order Number DE88004688/JAW.

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

A new family of aluminum-containing austenitic stainless steels has been used to make strong, hermetic glass-ceramic to metal seals. The new alloys contain approximately 4 to 5 wt % aluminum, and are strengthened via the precipitation of a secondary hardening phase during a typical glass to metal sealing and crystallization cycle. This is unlike other stainless steels which cannot be strengthened during heat treatment and are actually weakened during glass crystallization. In this paper, data are given on thermal expansion, alloy yeild strength, metallography, hermeticity, bond strength, weldability and glass-ceramic/metal interfacial structure. 13 refs., 8 figs., 1 tab.

15273 (N—88-11859, pp 5) High temperature superconductors. Wu, M.K. Sep 1987. NTIS, PC A06/MF A01. (NASA-CR—181508; NAS—1.26:181508).

In Consortium for Materials Development in Space. Technical section. Annual report, 15 September 1986-14 September 1987.

The two principle objectives are to develop materials that superconduct at higher temperatures and to better understand the mechanisms behind high temperature superconductivity. Experiments on the thermal reaction, structure, and physical properties of materials that exhibit superconductivity at high temperatures are discussed.

15274 (PB—88-854583/XAB) Radiation curing of polymers. December 1983-November 1986 (citations from the Engineering Index data base). Report for December 1983-November 1986. (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 148p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the radiation crosslinking of thermoplastic and thermosetting plastics and elastomers. Energy efficiency and performance of polymer curing by such radiation as ultraviolet, microwave and infrared wavelengths are discussed relative to such materials as polymeric coatings, adhesives, elastomers, and epoxy resins. Hazards of radiation curing of polymers as well as applications of the electron processed plastics are included. (This updated bibliography contains 324 citations, none of which are new entries to the previous edition.)

15275 (PB—88-854591/XAB) Radiation curing of polymers. December 1986-December 1987 (citations from the Engineering Index data base). Report for December 1986-December 1987. (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 62p. NTIS PC N01/MF N01.

Supersedes PB—87-851457.

This bibliography contains citations concerning the radiation crosslinking of thermoplastic and thermosetting plastics and elastomers. Energy efficiency and performance of polymer curing by such radiation as ultraviolet, microwave and infrared wavelengths are discussed relative to such materials as polymeric coatings, adhesives, elastomers, and epoxy resins. Hazards of radiation curing of polymers as well as applications of the electron processed plastics are included. (This updated bibliography contains 128 citations, all of which are new entries to the previous edition.)

15276 (PB—88-854807/XAB) Anaerobic adhesives and sealants. January 1970-December 1987 (citations from the US Patent data base). Report for January 1970-December 1987. (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 55p. NTIS PC N01/MF N01.

Supersedes PB—87-850590.

This bibliography contains citations of selected patents concerning anaerobically curable adhesive compositions and sealants. Polymethacrylate, and urethane-based compounds are among those discussed. Pressure-sensitive anaerobic adhesives, and bonding methods are included. (This updated bibliography contains 115 citations, 22 of which are new entries to the previous edition.)

15277 (PB—88-854898/XAB) Anaerobic adhesives and sealants. January 1973-December 1987 (citations from the Rubber and Plastics Research Association data base). Report for January 1973-December 1987. (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 69p. NTIS PC N01/MF N01.

Supersedes PB—87-850533.

This bibliography contains citations concerning the development and utilization of anaerobic adhesive and sealant materials and products. Topics include composition descriptions, market trends, curing characteristics, and use as structural adhesives. Engineering applications also include gasketing in the automotive industry, and pipe-thread sealing. Descriptions of specific products and tradenames are provided. (This updated bibliography contains 158 citations, 14 of which are new entries to the previous edition.)

15278 (PNL-SA—15180) Nucleation and growth of calcium carbonate crystals on surface-modified polyethylene and polystyrene. Rieke, P.C. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 7p. (CONF-870878—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005126/JAW.

From Conference on atomic and molecular processing of electronic and ceramic materials: preparation, characterization and properties; Seattle, WA, USA (31 Aug 1987).

Bone, tooth, and seashell are fracture-resistant, low-temperature derived ceramic/polymer composites which utilize inexpensive ceramic materials. By understanding how these composites are formed, man-made ceramic/polymer composites with similar or superior properties can be produced. The formation of calcified tissue in living organisms is controlled by the surface properties of the protein polymeric matrix undergoing calcification. Common polymers may also function as a suitable surface for crystal growth provided the surface can mimic the behavior of its natural protein counterpart. Polyethylene and polystyrene surfaces were chemically modified by chromic acid and sulfuric acid etching. The degree of modification was varied, and the rate and density of crystal nucleation and growth were monitored.

15279 (SAND—87-1110C-FP) Voltammetric investigation of porous silicon for integrated circuit applications. Kelly, M.J.; Guilinger, T.R.; Tsao, S.S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 14p. (CONF-871027—13-FP). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004024/JAW.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Porous silicon is used in the fabrication of dielectrically-isolated integrated circuits. We present an electrochemical model of porous silicon formation in dilute (0.1-5 F) hydrofluoric acid (HF). The mechanism involves the anodic dissolution of silicon, passivation of the pore walls by SiO_2, and depassivation by reaction of SiO_2 with HF. Thermodynamic and kinetic analysis of the mechanism is performed by voltammetry with various HF concentrations, scan rates, and electrode rotation rates. 14 refs., 6 figs.

15280 (SAND—87-1362C) Effect of density change on rapid liquid-solid interface kinetics and heat flow. Richards, P.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-871124—50). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004286/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Consequences of the need to transport density to or from a fast-moving liquid-solid interface are examined. There can be a severe limitation of the freezing velocity and a change in the amount of heat which must be conducted. The latter effect produces a net latent heat which can be significantly different from the equilibrium value and even change sign. 8 refs., 4 figs., 1 tab.

15281 (SAND—87-1486C) Atomistic simulation of low-energy beam deposition. Dodson, B.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-871124—20). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004344/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Low-energy (50 eV) homoepitaxial beam deposition of silicon is simulated using many-body silicon potentials and molecular dynamics techniques. Results are presented for the case of a 50 eV neutral silicon beam incident on the (2 x 1) dimer reconstructed Si(100) surface. The beam is aligned along (110) symmetry directions, which are the most natural channeling directions in the silicon lattice. Roughly 10% of the incident beam atoms are scattered from the surface with a small fraction of their initial energy. About half of the incident atoms penetrate the lattice, but scatter strongly and come to rest within 10 to 15 A of the surface. The remainder are steered accurately into the bulk (110) channels, where they penetrate some 30 to 100 A into the lattice. Those atoms which do not undergo bulk channeling cause considerable lattice damage to the near-surface (depth $\geq$ 10 A) region. 4 refs., 4 figs.

15282 (SAND—87-1504C) Stability diagrams for epitaxial strained layers. Tsao, J.Y.; Dodson, B.W.; Picraux, S.T. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-871124—31). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003935/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

For bulk materials, plastic deformation mechanisms and rates depend in a complex way on resolved shear stress and temperature, but can be succinctly described using deformation mechanism maps. We describe the use of such maps to demarcate the various stability and metastability regimes of single and multilayered strained epitaxial structures, and to interpret experimental work in the SiGe system. 16 refs., 4 figs.

15283 (SAND—87-1521C) Nonlinear optical waveguides containing a transition metal-based dye molecule. Cahill, P.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-871124—41). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003257/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Two pentaamine malonitrile ruthenium dyes that show sharp and intense absorption maxima near 800 nm have been synthesized for use as nonlinear optical (NLO) dyes. Preliminary powder measurements of crystals of these dyes for second harmonic generation (SHG) are reported for incident 1064 nm light. The anomalous dispersion due to the location of the one-photon absorption maximum has interesting consequences for phase matching, and calculations for inherently phase-matched single-mode waveguides are presented. 9 refs., 4 figs.

15284 (SAND—87-1598C) Comparison of low temperature photoluminescence of bulk MBE [Molecular Beam Epitaxy] grown AlGaAs and GaAs using a graphite generated dimer versus a standard tetramer arsenic group-V source. Brennan, T.M.; Hammons, B.E.; Smith, M.C.; Jones, E.D. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-871124—57). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004939/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The carbon concentrations in GaAs and AlGaAs grown by Molecular Beam Epitaxy (MBE) have been studied when a graphite generated dimeric arsenic species and a standard tetramer arsenic species are used as the group-V source. Photoluminescence and Van der Pauw-Hall measurements have been made to examine the material quality in reference to which arsenic species is used for film growth. Results indicate that a graphite crucible arrangement for the thermal cracking of As_4 produces significant carbon contamination and is unacceptable for the MBE growth of GaAs and AlGaAs. 15 refs., 3 figs.

15285 (SAND—87-2219) S-glass analysis by x-ray spectroscopy. Levine, H.S.; Thomas, E.V. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 17p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004636/JAW.

A rapid and accurate x-ray fluorescence (XRF) method for estimating concentrations of K_2O, SiO_2, Al_2O_3, P_2O_5, and (Li_2O + B_2O_3) in S-glass was developed based on the use of a fundamental parameters program, a set of secondary S-glass standards, and an iterative adjustment of Li_2O and/or B_2O_3 to a total unnormalized sample composition of 100 +- 0.01%. Errors introduced by the use of arbitrary and nonunique values of the light element unknown concentrations at the iterative endpoint were found to be small. Results obtained for S-glass ceramic lot 84 to 132 samples using this procedure compared well with the results of a round-robin study on the same glass. A statistical study on samples from lots 84 to 132 and 84 to 133 showed good analytical precision with relative measurement errors on the order of 0.5% for all components. This precision allowed detection of relatively small, but significant, sample-to-sample variations in chemical composition. In addition, it was demonstrated that the quality of the standards influences the accuracy of the results. 2 refs., 9 tabs.

15286 (SAND—87-2870C) Ion beam modification of film stress and the effectiveness of thin film encapsulants on GaAs. Haynes, T.E.; Picraux, S.T.; Lee, S.R.; Chu, W.K. (North Carolina Univ., Chapel Hill (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-871124—49). NTIS, PC A02. Order Number DE88004458/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Ion implantation has been used to modify the initial stress in thin (40 nm) SiO_2 films on GaAs, and to condition the SiO_2-GaAs interface to promote adhesion. The effectiveness of these implanted films as caps to suppress decomposition of GaAs during rapid thermal processing has been studied, and this provides an indicator of the mechanical stability of the films. Measurements of the initial film stress, as well as stress changes caused by implantation and annealing, have been made to help interpret the implantation results. Our results indicate that ion implantation does not have a strong

effect on the performance of thin film SiO_2 encapsulants on GaAs. 17 refs., 4 figs., 1 tab.

15287 (SAND—87-7019) Characterization of majority and minority carrier transport in heavily doped silicon. Swanson, R.M.; Swirhun, S.E. (Stanford Univ., CA (USA). Stanford Electronics Labs.). Nov 1987. Contract AC04-76DP00789. 333p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE88005247/JAW.

Majority carrier transport in bulk heavily doped silicon is characterized by means of conductivity and Hall coefficient measurements as a function of temperature from 80 to 370°K. The equilibrium majority bulk carrier density and Hall mobility and their dependence on temperature are extracted. Majority carrier transport at ohmic metal-semiconductor interfaces is characterized by measuring specific contact resistivity as a function of doping density and temperature using planar test structures. The results are compared to existing theory. Minority carrier transport in bulk heavily doped silicon is characterized by measuring three parameters - lifetime, mobility, and carrier density. Bulk minority carrier lifetime is measured using an all-optical photoluminescence technique. Bulk minority carrier mobility and equilibrium minority carrier density (or equivalently, band-gap narrowing) are measured using bipolar transistor test structures with uniformly heavily doped base regions. The temperature dependence of mobility and band-gap narrowing is measured. Minority carrier transport at insulating interfaces is characterized by measuring surface recombination. The fundamental surface recombination velocity of the $Si:P/SiO_2$ interface is characterized as a function of doping density with electrical measurements of gated-base vertical transistors.

15288 (SAND—87-8930) Nonlinear absorption of CO_2 laser radiation in p-type InSb. James, R.B.; Chang, Y.C.; Smith, D.L. (Sandia National Labs., Livermore, CA (USA); Illinois Univ., Urbana (USA); Los Alamos National Lab., NM (USA)). Dec 1987. Contract AC04-76DR00789. 9p. (CONF-871147—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004055/JAW.

From 3. international laser science conference; Atlantic City, NJ, USA (1 Nov 1987).

Calculations of the intervalence-band absorption saturation in p-type InSb by high-intensity CO_2 laser light are reported. The intensity-dependent absorption coefficient is found to be well described by an inhomogeneously broadened two-level model, and values of the saturation intensity are presented. 14 refs., 2 figs.

15289 (SAND—87-8987) Melting of silicon surfaces by high-power pulsed microwave radiation. James, R.B.; Bolton, P.R.; Alvarez, R.A.; Christie, W.H.; Valiga, R.E. (Sandia National Labs., Livermore, CA (USA); Lawrence Livermore National Lab., CA (USA); Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC04-76DR00789. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005205/JAW.

We have measured the microwave-induced melting and damage to the near-surface region of arsenic-implanted silicon for 1 to 2 μs pulses at 2.856 GHz and up to 10 MW pulse. The results of time-resolved optical measurements for samples irradiated in vacuo show that melting of the near-surface region occurs for pulse powers exceeding 3 MW, and that the surface melting is accompanied by a large increase in the reflected microwave power. The onset of the enhanced reflectivity is measured at an earlier time as the microwave power is increased, and once the abrupt increase in the reflectivity is observed, it persists throughout the remainder of the pulse. Simultaneous with the onset of surface damage, we observe a large enhancement in the emission of light from the sample. Results are presented for the temporal behavior and spectra components of the fluorescence as a function of the incident microwave power. A large increase in the gas pressure was detected at the same pulse power as the threshold for the sudden increase in the microwave reflectivity. The large increments in the reflected microwave power, light emission, and gas pressure are attributed to the formation of a plasma due to gas breakdown at or near the sample surface. The melting and damage are not homogeneous over the surface, and the degree of energy deposition from the microwave pulses depends on the ambient gas in the test cell. Microwave pulses at a power of 8 MW cause melting and vaporization of the near-surface region up to depths that exceed 1 μm. 9 refs., 15 figs.

15290 (VTT-TIED—717) Belt drives in arctic conditions. Lehto, A. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). May 1987. 25p. NTIS (US Sales Only), PC A03. Order Number DE88751088/JAW.

Problems concerning the behaviour of power transmission belts at low temperatures were studied experimentally. A belt drive, designed according to the standard SFS 3527, was used at low temperatures. The minimum service temperature was determined for ten v-belts and one timing belt. The influence of pulley diameter, loading, tensioning method and storage time at low temperatures was studied experimentally. The main problems when using belts at low temperatures were caused by rubber materials becoming stiff and brittle. That increased the starting torques of the belts, and caused cracks in the top or the bottom rubber of the belt.

15291 (VTT-TUTK—485) Fire tests on loose-fill insulation materials. Kokkala, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1987. 81p. NTIS (US Sales Only), PC A05/MF A01 . Order Number DE88751182/JAW.

A short review of the physical and chemical processes involved in smouldering fires of loose-fill insulation materials is presented. Various official and inofficial fire test methods are described and evaluated. Results of a series of tests made to evaluate the British Standard BS 5803:Part 4:1985 are presented. A proposal for a Nordtest method based on this standard is given as an apprendix.

15292 Initial evaporation rates from GaAs during rapid thermal processing. Haynes, T.E.; Chu, W.K.; Aselage, T.L.; Picraux, S.T. (Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27514). *Journal of Applied Physics;* **63**: No. 4, 1168-1176(15 Feb 1988).

The initial rates of evaporation of Ga and As from the surface of single-crystal GaAs during rapid thermal processing (RTP) have been determined in the temperature range from 600 to 750 °C. Absolute vaporization rates for capless annealing of GaAs were measured by collecting the evaporated species on a copper film, which condenses 50%—100% of the evaporated material. Initial evaporation rates during RTP are shown to be in agreement with the maximum predicted rates based on the Hertz—Knudsen equation. In a second set of experiments, the preferential loss of arsenic for GaAs-GaAs proximity annealing was measured using ion channeling. All experimental results are interpreted in terms of a model which we develop for capless and proximity annealing based on the kinetic theory of gases.

15293 Analysis of He-implanted $LiNbO_3$ by elastic recoil detection. Al-Chalabi, S.A.M.; Weiss, B.L.; Barfoot, K.M.; Arnold, G.W. (Department of Electronic and Electrical Engineering, University of Surrey, Guildford, Surrey GU2 5XH, England). *Journal of Applied Physics;* **63**: No. 4, 1032-1036(15 Feb 1988).

He-implanted samples of $LiNbO_3$ have been analyzed by 24-MeV ^{28}Si elastic recoil detection. For 50-keV He implants, the Li and H profiles show a depletion of Li from the sample near-surface region which coincides with a gain of H. The Li loss is seen to increase with increasing ion fluence and implantation temperature.

15294 Organometallic vapor phase epitaxial growth of a new semiconductor alloy: GaP/sub 1-//sub x/Sb/sub x/. Jou, M.J.; Cherng, Y.T.; Jen, H.R.; Stringfellow, G.B. (Department of Materials Science and Engineering, University of Utah, Salt Lake City, Utah 84112). *Applied Physics Letters;* **52**: No. 7, 549-551(15 Feb 1988).

The III/V semiconductor alloy GaP/sub 1-//sub x/Sb/sub x/ has been grown for the first time. This alloy, which has a large miscibility gap at the growth temperatures of 530—600 °C, has been grown by organometallic vapor phase epitaxy at atmospheric pressure. In spite of the miscibility gap, which is calculated to extend from x = 0.01 to 0.99 at 530 °C, layers with excellent surface morphologies could be grown throughout the entire composi-

tion range. The 10 K energy band gap has been determined as a function of composition by using photoluminescence, x-ray diffraction, and electron microprobe analysis, yielding bowing parameters of 3.8 and 2.7 eV for the Γ and X conduction band minima, respectively.

15295 **Stress variations and relief in patterned GaAs grown on mismatched substrates.** Yacobi, B.G.; Jagannath, C.; Zemon, S.; Sheldon, P. (GTE Laboratories, Waltham, Massachusetts 02254). *Applied Physics Letters;* **52**: No. 7, 555-557(15 Feb 1988).

Cathodoluminescence scanning electron microscopy studies reveal significant variations in stress across etched patterns of GaAs grown on both InP and Si substrates. The stress in the epilayer is relieved at convex corners and in patterned areas with dimensions on the order of 10 μm. The stress is uniaxial near the edge of a patterned region and changes to biaxial away from the edge, producing nonuniformities in the optical properties of patterned regions.

15296 **Characterization of GaAs film grown on Si substrate by photoluminescence at 77 K.** Huang, Y.; Yu, P.Y.; Lee, H.; Wang, S. (Department of Physics, University of California, and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Applied Physics Letters;* **52**: No. 7, 579-581(15 Feb 1988).

Photoluminescence of GaAs films grown on Si substrate has been investigated quantitatively at 77 K. The peak shift and splitting of the exciton luminescence are shown to result from tensile stress in the film. Information on carrier lifetime has been deduced from the line shape of the photoluminescence.

15297 **Dispersion and dipole activity of surface phonons on Si(111) 2 x 1.** Alerhand, O.L.; Mele, E.J. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6396). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 5, 2536-2550(15 Feb 1988).

Using an empirical tight-binding theory for structural energies we study vibrational excitations on the π-bonded chain model of the Si(111) 2 x 1 surface. We calculate the phonon spectrum of the surface and find a number of modes that have the form of elementary vibrational excitations of the zigzag chains of surface atoms of the reconstructed surface. In the acoustic part of the spectrum a strong phonon-energy renormalization effect generated by electronic transitions causes an unusual softening of the Rayleigh wave at the zone boundary; this result is consistent with recent He-atom scattering experiments. We also calculate the linearized response of the charge density to lattice displacements, which we use to obtain the phonon-assisted contribution to the surface conductivity. A longitudinal-optical phonon along the surface zigzag chains generates a very large dynamic charge (~0.75e) and is assigned to the anomalously strong dipole-active surface phonon that has been observed experimentally by high-resolution electron-energy-loss spectroscopy.

15298 **Effects on vibrational and electronic properties of removing hydrogen atoms in hydrogenated amorphous silicon.** Nelson, J.S.; Fong, C.Y.; Guttman, L.; Batra, I.P. (Department of Physics, University of California, Davis, California 95616). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 5, 2622-2629(15 Feb 1988).

The effects of removing hydrogen atoms on the vibrational and the electronic properties of hydrogenated amorphous silicon (a-Si:H) have been investigated. Besides the missing vibrational modes associated with the removal of H atoms, the changes in the Si-dominated modes can be correlated to local distortions at the site of the Si whose neighboring H was removed. The dangling-bond states have an average energy at 0.2 eV above the top of the valence band, which is 0.5 eV smaller than the generally accepted value for the electronic level with g = 2.0055. The range of interaction between the dangling-bond states is about equal to the second-neighbor distance (≦4 A). Comparison of the electronic states with and without the presence of the hydrogen atoms allows us to locate the Si-H bonding states at 5.0 and 7.5 eV below the top of the valence band.

15299 **Plasmon broadening and temperature effects on the plasmon-phonon-assisted recombination in silicon.** Rasolt, M.; Perrot, F. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6061). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 5, 2630-2635(15 Feb 1988). Contract AC05-84OR21400.

We present a detailed theoretical calculation of the plasmon-phonon-assisted recombination (PPAR) in a highly laser excited electron-hole plasma of silicon. We present results for PPAR as a function of carrier density, lattice temperature, and carrier temperature and show that the results are consistent with reflectivity measurements in Si in the picosecond and femtosecond pump- to probe-beam delay time.

15300 **Simulation of the structure of amorphous silicon dioxide.** Guttman, L.; Rahman, S.M. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 5, 2657-2668(15 Feb 1988). Contract W-31-109-ENG-38.

Computer models of amorphous silicon dioxide have been generated by systematic procedures. The models are all stoichiometric, perfectly coordinated and periodic, and composed of SiO_4 tetrahedra sharing corners to form a random network. Starting from various random arrangements, each example is subjected to a series of modifications of its connectivity which reduce its potential energy under a valence-force type of potential function. Several examples have been constructed for each of four choices of starting point and method of connectivity modification. The number of silicon atoms in the repeating unit has been varied from 30 to 108, with twice as many oxygen atoms. The force constants have been chosen by comparison with experiment of the computed density and elastic moduli. The calculated neutron scattering of many of the examples is in excellent agreement with recent experiments of high precision. However, examples containing rings of three or four tetrahedra show scattering at small momentum transfer which deviates increasingly from experiment as the numbers of these rings increase.

15301 **Optical transitions in neutron-irradiated $MgAl_2O_4$ spinel crystals.** Cain, L.S.; Pogatshnik, G.J.; Chen, Y. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6061). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 5, 2645-2652(15 Feb 1988). Contract AC05-84OR21400.

Neutron irradiation of $MgAl_2O_4$ spinel crystals produces an F-center absorption band in the uv accompanied by a broad absorption band in the visible region. Excitation and emission experiments identify the observed structure in the visible absorption band as optical transitions of transition-metal impurity ions perturbed by neighboring F centers. The perturbation of the F center increases the oscillator strengths for these transitions by more than 3 orders of magnitude. The results of these experiments suggest that the 480-nm emission band, previously attributed to the F center, is also due to a transition-metal impurity.

15302 **Evidence for phonon-assisted positronium emission from graphite.** Sferlazzo, P.; Berko, S.; Lynn, K.G.; Mills A.P. Jr.; Roellig, L.O.; Viescas, A.J.; West, R.N. (Brandeis University, Waltham, Massachusetts 02154). *Physical Review Letters;* **60**: No. 6, 538-541(8 Feb 1988).

We observe positronium (Ps) emission from a graphite surface being bombarded by slow positrons. The band structure of graphite does not support the usual one-electron-hole process for Ps formation because of conservation of momentum parallel to the surface. A large temperature coefficient for the emission of energetic Ps suggests a new mechanism in which momentum conservation is satisfied by the emission and absorption of phonons. A simple theory including one-phonon processes explains the temperature dependence as well as the angular distribution of the Ps.

15303 **Controversy of critical layer thickness for InGaAs/GaAs strained-layer epitaxy.** Gourley, P.L.; Fritz, I.J.; Dawson, L.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **52**: No. 5, 377-379(1 Feb 1988). Contract AC04-76DP00789.

The critical layer thickness for In/sub x/Ga/sub 1-//sub x/As layers in In/sub x/Ga/sub 1-//sub x/As/GaAs single strained quantum wells (SSQW's) and strained-layer superlattices (SLS's) are investigated. Photoluminescence microscopy (PLM) images and x-ray rocking curves for two series of SSQW and SLS structures corresponding to many different layer thicknesses were obtained. We find that the PLM technique, which directly images dislocations and is sensitive to low dislocation densities, is much more suitable for determining the onset of dislocation creation. The x-ray technique can detect lattice relaxation by dislocations but only at relatively high densities of dislocations. Using the former technique, we determine critical thicknesses of 190 A for SSQW's and 250 A for SLS's with x≅0.2. These results are near the theoretical predictions of J. W. Matthews, S. Mader, and T. B. Light [J. Appl. Phys. 41, 3800 (1970)] (150 and 300 A, respectively) and are much lower than results obtained by x-ray or other techniques which sense lattice relaxation.

15304 **Structure and recombination in InGaAs/GaAs heterostructures.** Fitzgerald, E.A.; Ast, D.G.; Kirchner, P.D.; Pettit, G.D.; Woodall, J.M. (Department of Materials Science and Engineering, Cornell University, Ithaca, New York 14853). *Journal of Applied Physics;* 63: No. 3, 693-703(1 Feb 1988).

The defect structure of lattice-mismatched 1-μm In/sub x/Ga/sub 1-//sub x/As (x≅0.12, misfit $\Delta a/a \cong 8.5 \times 10^{-3}$) epilayers on GaAs was studied with scanning cathodoluminescence (CL), transmission electron microscopy (TEM), high-voltage electron microscopy, and scanning electron microscopy. CL shows that nonradiative recombination lines exist in the GaAs buffer layer as far as 4000 A from the interface. The density of these defects is independent of substrate dislocation density. Plan-view TEM analysis indicates that the majority of these dislocations in the buffer layer are sessile edge half-loops. Cross-sectional TEM shows that loops also extend into the InGaAs epilayer, but the majority of the loops are located on the buffer layer (substrate) side of the interface. A model is proposed to explain sessile edge dislocation formation in the buffer layer. A comparison of CL and high-voltage electron microscopy images from the same interface area reveals that the dark nonradiative recombination lines seen in scanning luminescence images in this high misfit system do not correspond to the normal, isolated misfit dislocation. The nonradiative recombination line spacing is 3 μm, whereas the interface dislocation spacing is 400—1000 A. It is shown that the nonradiative recombination lines observed in CL of the interface correspond to specific groups of dislocations with different TEM contrast behavior. The dark nonradiative recombination lines also correlate with asymmetric surface ridges, suggesting that they introduce preferred nucleation sites, and that these effects are different for the two <110> directions.

15305 **Photoacoustic measurement technique using acoustic phase perturbation.** Stearns, R.G. (Edward L. Ginzton Laboratories, W. W. Hansen Laboratories of Physics, Stanford University, Stanford, California 94305). *Journal of Applied Physics;* 63: No. 3, 640-648(1 Feb 1988).

A novel photoacoustic measurement technique is introduced, which is based on the phase perturbation of an external acoustic wave that propagates through a region of material irradiated by an optical beam. The mechanism of the perturbation is the local change in acoustic velocity due to heating of the irradiated sample. Because the acoustic phase perturbation may be calibrated directly, it is found that the absolute optical absorption coefficient of the irradiated sample may be determined using the technique. Both the experimental phase detection system and a theoretical analysis of the acoustic perturbation are discussed. Finally, an experiment is described in detail, where the measurement technique is used to determine the absolute optical absorption coefficient of a liquid.

15306 **Measurement of atomic-hydrogen diffusion in helium.** Redsun, S.G.; Knize, R.J. (Department of Physics and Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physical Review* [*Section*] *A: General Physics;* 37: No. 3, 737-746(1 Feb 1988).

The diffusion constant of atomic hydrogen in helium gas, D_0(H-He), was measured with use of an optical-pumping—spin-exchange technique. Atomic hydrogen was produced by an inductive discharge in spherical Pyrex cells containing helium and small amounts of molecular hydrogen (<2%) and rubidium. The rubidium was optically pumped by a vapor lamp and the hydrogen was polarized by subsequent spin-exchange collisions. The decay rate of the hydrogen concentration was obtained from the observed time dependence of the hydrogen Zeeman signal and the diffusion constant was determined by measuring the decay rate in cells of different radius and helium pressure. D_0(H-He) was found to be 2.42(7) cm² sec/sup -1/ at 60 °C, which may be extrapolated to 1.70(5) cm² sec/sup -1/ at 0 °C. This result is significantly more accurate and more consistent with theoretical calculations than the results of previous experiments.

15307 **Enhanced adhesion at oxide/oxide interfaces by ion beam stitching.** Musket, R.G.; Thomas, I.M.; Wilder, J.G. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Applied Physics Letters;* 52: No. 5, 410-412(1 Feb 1988). Contract W-7405-ENG-48.

The adhesion of antireflective, porous SiO_2 coatings on fused silica substrates has been dramatically improved by irradiation with 200 keV helium ions. The approximately 220-nm-thick coatings consisted of layers of spherical, 20-nm-diam silica particles. Although the as-deposited coatings had only low adhesion, coatings irradiated with doses greater than 10^{14} He/cm² passed both adhesive-tape and abrasive-resistance tests. Since these coatings are used on optical elements for 1064 nm high-power lasers, the effect of the helium irradiation on optical transmission was determined.

15308 **Ortho-to-para conversion in solid tritium. I. Theoretical models.** Cao, Y.; Gaines, J.R.; Fedders, P.A.; Souers, P.C. (Department of Physics, Ohio State University, Columbus, Ohio 43210). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 4, 1474-1481(1 Feb 1988).

Reliable theoretical models developed to calculate the intrinsic ortho-to-para conversion rate in orientationally ordered solid H_2 are used to estimate the conversion rate in solid T_2. Since the Debye energy is larger than the rotational energy difference between the J = 1 level and the ground state J = 0, both the single-phonon transition probability and the transition probability due to the Raman effect must be taken into account. These additional intrinsic processes are treated here, but are found to be too weak to account for the experimentally observed rates. The single-phonon conversion rate due to unpaired electron spins in the solid is obtained for both localized and mobile spins. The conversion rate due to mobile unpaired electron spins is large enough to account for the experimental data if the atom density is of order 10/sup 18/ atoms per cm³.

15309 **Ortho-to-para conversion in solid tritium. II. Experimental values.** Sater, J.D.; Gaines, J.R.; Fearon, E.M.; Souers, P.C.; McMurphy, F.E.; Mapoles, E.R. (Department of Physics, Ohio State University, Columbus, Ohio 43210). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 4, 1482-1491(1 Feb 1988).

Nuclear-magnetic-resonance signal heights at a Larmor frequency of 30 MHz are used to monitor the ortho-T_2 concentration as a function of time at fixed temperature in solid T_2. The ortho-T_2 concentration decreases with time due to ortho-to-para conversion in the solid. From our measurements, we find that the difference between the instantaneous signal height and the equilibrium signal height decays exponentially with time. The time constant of this decay has a minimum near 11.4 K indicative of a peak in the conversion rate near 11 K. The equilibrium signal height is observed to be larger than expected from the Boltzmann distribution. The conversion-rate data are interpreted in terms of a model where the conversion is due to electron spins (on atoms) capable of translational diffusion. The peak in the conversion rate is used to determine the characteristic frequency of the problem and the temperature dependence of the correlation time of the electron spins. The enhanced equilibrium signal is interpreted as arising from a preferential pumping of the J = 1 ortho-T_2 level due to atom recombination. A model-dependent recombination coefficient for the atoms is extracted from the data, predicting an equilibrium number of atoms that is strongly temperature dependent.

15310 **Comparative optical reflectance study of the superconducting KHg-graphite and CsBi/sub x/-graphite intercalation compounds.** Yang, M.H.; Charron, P.A.; Heinz, R.E.; Eklund, P.C. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). *Physical Review [Section] B: Condensed Matter;* 37: No. 4, 1711-1718(1 Feb 1988).

We report the results of a comparative optical reflectance study at room temperature of the stage-1 and stage-2 CsBi/sub x/ and KHg graphite intercalation compounds (GIC's) in the energy range 0.2—10 eV. A Kramers-Kronig analysis is carried out to determine the dielectric function $\epsilon(\omega) = \epsilon_1(\omega)+\epsilon_2(\omega)$ and the intra- and interband contributions to $\epsilon(\omega)$ are identified. The dielectric function for the respective compounds are analyzed in terms of a schematic density-of-states model involving contributions from two-dimensional graphite π band(s) and intercalate bands. Separate contributions from the π and intercalate electrons to the free-carrier plasma frequency are determined via the identification of the carbon $\pi\rightarrow\pi$/sup */ interband absorption threshold E/sub T/ ~2E/sub F/, where E/sub F/ is the Fermi energy measured with respect to the approximate mirror plane in the carbon π-band structure. The analysis of the optical data indicates that for CsBi/sub x/ GIC's, the electrical transport properties should be dominated by the light carbon π-band electrons in contrast to the KHg GIC's, where the analysis indicates the transport properties should strongly depend on free carriers in both the π/sup */ and the intercalate band(s). In the case of KHg GIC's, our interpretation of the experimental results are consistent with significant occupation of electronic states with Hg(6s) character. Our results suggest that nature of the superconductivity in the KHg and CsBi/sub x/ GIC's should be quite different.

15311 **Studies of the electronic phase transition in Lu_5Ir_4Si/sub 10/ and Lu_5Rh_4Si/sub 10/ by /sup 175/Lu-NMR.** Chu, P.; Gerstein, B.C.; Yang, H.D.; Shelton, R.N. (Department of Chemistry and Energy and Mineral Resources Research Institute, Iowa State University, Ames, Iowa 50010). *Physical Review [Section] B: Condensed Matter;* 37: No. 4, 1796-1806(1 Feb 1988).

Pulsed nuclear magnetic resonance of /sup 175/Lu (I = (7/2) was used to study the electronic phase transition of samples Lu_5Ir_4Si/sub 10/ and Lu_5Rh_4Si/sub 10/ under atmospheric pressure from 49 to 310 K. A calculation of the powder line shape in the quadrupole regime for I = (7/2 shows that the critical frequencies, particularly that of the singularity, are sensitive to the change of the electric-field-gradient (EFG) asymmetry and the Larmor frequency. From the singularity near $\nu = \nu_0$, the EFG asymmetry of the lutetium nucleus is estimated to be $\eta_{Lu} \approx 0.4$. The temperature coefficient of the lutetium EFG asymmetry as estimated from the temperature-dependent shift is close to 3 x 10/sup -5/ K/sup -1/. This small variation of the EFG asymmetry suggests that the crystal structure remains unchanged in the temperature range studied. The possible formation of charge-density-wave states at 83 and 145 K for the two compounds, respectively, is indicated by anomalous variations of the temperature-dependent Knight shift. A loss of the electronic density of states at the Fermi level, as inferred from the jump discontinuity of the Knight shift, is consistent with previous measurements of resistivity and the magnetic susceptibility on these samples. From the correlation of the Knight shift with the magnetic susceptibility, the hyperfine field is determined to be 0.5 and 0.7 MOe, a value consistent with the previous measurements of rare-earth metals. The NMR of /sup 45/Sc (I = (7/2) in Sc_5Ir_4Si/sub 10/, isostructural with the above two compounds, was used as a baseline measurement to illustrate the anomalous behavior observed for /sup 175/Lu in Lu_5M_4Si/sub 10/ (M = Ir,Rh).

15312 **Automated outgassing facility with inductive heating.** Simpkins, J.E.; Mioduszewski, P.K. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Review of Scientific Instruments;* 59: No. 2, 276-279(Feb 1988). Contract AC05-84OR21400.

The use of graphite for both first walls and limiters in fusion experiments has increased during recent years. However, graphite contains large amounts of gaseous contaminants that affect the plasma adversely. To study the vacuum characteristics of various candidate graphites and to evaluate conditioning techniques for these materials, we have built an outgassing facility, which is described in this paper. Induction heating is used to heat the sample to 2000 °C. This heating technique was chosen to avoid heating other components in the vacuum chamber. Since the walls are heated by radiation from the sample at the higher temperatures, they are kept at a constant elevated temperature of 100 °C by thermostatically controlled heaters throughout the experiment. The entire system is automated. Some results that compare POCO and pyrolytic graphites are shown.

15313 **Effect of strain on the band structure of GaAs and In/sub 0.2/Ga/sub 0.8/As.** Hwang, J.; Shih, C.K.; Pianetta, P.; Kubiak, G.D.; Stulen, R.H.; Dawson, L.R.; Pao, Y.; Harris J.S. Jr. (Stanford Synchrotron Radiation Laboratory, Stanford University, Stanford, California 94305). *Applied Physics Letters;* 52: No. 4, 308-310(25 Jan 1988). Contract AC04-76DP00789.

The valence-band structures of 50-A-thick layers of GaAs(001) in tension and In/sub 0.2/Ga/sub 0.8/As(001) in compression have been determined using angle-resolved photoemission spectroscopy. Our studies show that the $\Delta3+\Delta4$ bands and the $\Delta1$ band respond differently to the strain perturbation. For strained GaAs(001), the $\Delta3+\Delta4$ bands (P/sub x/+P/sub y/-like) are shifted up in energy by a maximum amount of 0.3 eV, while in contrast, the $\Delta1$ band (P/sub z/-like) is shifted down by about 0.1 eV. For strained In/sub 0.2/Ga/sub 0.8/As(001), the band shifts are in the opposite direction, consistent with the opposite strain conditions. For both materials, the strain-induced changes cannot be characterized simply by rigid band shifts, but rather exhibit significant wave vector dependence. This results in a reduction of the effective mass of the $\Delta3+\Delta4$ bands for both GaAs and In/sub 0.2/Ga/sub 0.8/As.

15314 **Nonequilibrium structure during phase separation.** Wilcoxon, J.P.; Schaefer, D.W.; Kaler, E.W. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800). *Physical Review Letters;* 60: No. 4, 333-336(25 Jan 1988). Contract AC04-76DP00789.

To establish the nature of the early stage structures that occur during phase separation, we studied solutions of a nonionic surfactant micellar solution (C/sub 12/E_8 in D_2O). We report the existence of long-lived nonequilibrium structures during shallow quenches along the critical isochore. The power-law scattering profile of these structures is consistent with ramified clusters with a fractal dimension D = 1.6 +- 0.1.

15315 **Photoluminescence studies of selective-area molecular beam epitaxy of GaAs film on Si substrate.** Lee, H.P.; Wang, S.; Huang, Y.; Yu, P. (Department of Electrical Engineering and Computer Sciences and Electronics Research Laboratory, University of California, Berkeley, California 94720). *Applied Physics Letters;* 52: No. 3, 215-217(18 Jan 1988).

GaAs films have been grown on Si substrates patterned with SiN by molecular beam epitaxy. The pattern consists of bare Si stripe of width ranging from 10 to 100 μm surrounded by SiN on both sides and a reference area of bare Si. 77 K photoluminescence (PL) spectrum and intensity are measured on the single crystalline GaAs films grown on these stripes and the reference area. For 1.5- and 3-μm-thick films, PL intensity from the 10 μm stripe shows 140% and 75% increase over the reference area, respectively. This remarkable increase in the PL intensity is believed due to the reduction of dislocations inside the window area. The improvement in the optical quality makes selective-area molecular beam epitaxy a very attractive technique for the fabrication of optical devices on Si substrate.

15316 **Free-electron laser study of the nonlinear magneto-photoconductivity in n-GaAs.** Kaminski, J.; Spector, J.; Prettl, W.; Weispfenning, M. (Department of Physics and Center for Free Electron Laser Studies, University of California, Santa Barbara, California 93106). *Applied Physics Letters;* 52: No. 3, 233-235(18 Jan 1988).

The University of California at Santa Barbara free-electron laser was used to investigate the kinetics of electrons bound to shallow donors in n-GaAs by saturation spectroscopy. The resonant

photothermal conductivity arising from 1s—$2p^+$ shallow donor excitations in a magnetic field was measured at intensities greatly exceeding that of earlier investigations and saturation of bound-to-free photoionization transitions was achieved. The impurity resonance photoconductive signal shows a distinct intensity dependence caused by competing bound-to-free transitions which saturate differently. This permits a more detailed evaluation of the electron recombination kinetics than was previously possible, yielding the ionization probability of the $2p^+$ state, the transition time of electrons from the $2p^+$ level to the gound state, and the recombination time of free carriers.

15317 **Explosive crystallization in amorphous Si initiated by long pulse width laser irradiation.** Peercy, P.S.; Tsao, J.Y.; Stiffler, S.R.; Thompson, M.O. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* 52: No. 3, 203-205(18 Jan 1988). Contract AC04-76DP00789.

Explosive crystallization of amorphous Si is studied in a new heat-flow regime using long pulse (45 ns full width at half-maximum) ruby laser irradiation. In this regime, previously unobserved phenomena are found. Nucleation of crystalline Si is observed while the amorphous phase is melting at high (m/s) velocity and epitaxy from the underlying crystalline substrate is observed even under conditions for which the amorphous Si is never at any instant fully melted. These measurements, combined with previous measurements using short pulse irradiation, lead to development of a more complete model of explosive crystallization.

15318 **Optical absorption of amorphous-Si:H/amorphous-Si/sub x/N/sub 1-//sub x/:H multilayers: Effects of interface alloying.** Mui, K.; Smith, F.W. (Department of Physics, City College of the City University of New York, New York, New York 10031). *Journal of Applied Physics;* 63: No. 2, 475-478(15 Jan 1988).

A model for the optical absorption of a-Si:H/a-Si/sub x/N/sub 1-//sub x/ :H multilayers has been developed which takes into account the effects of alloying in the interface regions between the a-Si:H and a-Si/sub x/N/sub 1-//sub x/ :H layers. Four different spatial variations of the film composition at the interfaces have been considered: abrupt, step, linear, and parabolic. The optical response of the interface regions is proposed to arise from Si-centered tetrahedra, containing both Si and N atoms. Calculations of the dielectric function of the multilayer using the appropriate effective medium approximation have indicated that alloying at the interfaces leads to a lower optical absorption and a broadening of the multilayer absorption edge as compared to multilayers in which interface alloying is ignored. However, interface alloying apparently does not contribute appreciably to the observed increase in the optical energy gap of the a-Si:H layer in the limit of decreasing layer thickness.

15319 **Resonant Raman scattering in metals at the interband absorption threshold.** Eklund, P.C.; Mahan, G.D.; Spolar, J.G.; Zhang, J.M.; Arakawa, E.T.; Hoffman, D.M. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 2, 691-698(15 Jan 1988).

A resonance in the cross section for Raman scattering of the incident photon accompanied by the emission of an intralayer phonon is observed in a series of p-type, quasi-two-dimensional metals formed by the electrochemical intercalation of graphite in sulfuric acid. The resonance in the cross section is observed to coincide with the inter-π-band absorption threshold, consistent with our theoretical calculations. The Raman matrix elements are calculated using the standard three-step scattering process. A rigid-band model is used for the carbon π states within a few eV of the Fermi level, and the electron-phonon interaction V/sub e//sub -//sub ph/ is calculated in the deformation-potential approximation. The theory shows that the resonance is a general phenomenon which should be observable in all metals.

15320 **Structural study of amorphous hydrogenated and unhydrogenated titanium carbide thin films by extended x-ray-absorption fine structure and extended electron-energy-loss fine structure.** Kaloyeros, A.E.; Williams, W.S.; Brown, F.C.; Greene, A.E.; Woodhouse, J.B. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 2, 771-784(15 Jan 1988). Contract AC02-76ER01198.

Thin films of hydrogenated and unhydrogenated titanium carbide, known to be amorphous from x-ray and electron diffraction studies, nevertheless exhibit short-range order at the level of the first-nearest-neighbor shell when studied by extended x-ray-absorption fine structure and extended electron-energy-loss fine structure. This short-range order appears to consist of the same octahedrally coordinated units present in crystalline titanium carbide (NaCl structure), where a titanium atom is surrounded by an octahedron of six carbon atoms and vice versa. The persistence of this basic structural unit is attributed to the difference in atomic radii between C and Ti and to the strong nature of the Ti-C bond. A slight relaxation in interatomic distance relative to the crystalline state, which increases upon hydrogenation, is also observed. The atomic positions in the first coordination shell in amorphous titanium carbide are slightly displaced relative to the crystalline form. Yet, upon hydrogenation, this displacement decreases in the first shell, made of carbon atoms and vacancies, surrounding a Ti atom by 40% for the 4.5 at. % H and 60% for the 6 at. % H relative to the unhydrogenated amorphous TiC/sub x/ films. By contrast, the structural disorder in the first shell of Ti atoms surrounding a C atom is practically unaffected by the addition of hydrogen. These results imply that the hydrogen atoms, instead of occupying tetrahedral vacancies, fill carbon vacancies in the amorphous phase as they do in crystalline TiC/sub x/, in agreement with our previous findings from static secondary-ion mass spectroscopy and x-ray photoelectron spectroscopy.

15321 **Influence of surface charge on free-carrier density profiles in GaAs films: Application to second-harmonic generation by free carriers.** Streight, S.R.; Mills, D.L. (Department of Physics, University of California, Irvine, California 92717). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 2, 965-973(15 Jan 1988).

We calculate, self-consistently, free-carrier density profiles and wave functions in GaAs films with surface charge present, by virtue of charged surface states or an applied external electric field. We explore the regime from the case where the free carriers are distributed roughly uniformly over the film, to the case where the surface charge localizes them to the near vicinity of one or both surfaces. This is done by both a Fourier transform and a real-space procedure (finite-difference method); the latter is found highly efficient. We also calculate the integrated strength of second-harmonic current induced in the free carriers near the surface by far-infrared radiation with frequency well below the free-carrier plasma frequency. We find values of the dimensionless parameter which controls the strength of the second-harmonic current to be substantially smaller than those reported recently by Weber and Liebsch, and argue that screening provided by interband transitions is responsible for this difference.

15322 **Dynamics of xenon, krypton, and methane monolayers in registry with graphite.** Hakim, T.M.; Glyde, H.R.; Chui, S.T. (Department of Physics, University of Delaware, Newark, Delaware 19716). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 2, 974-983(15 Jan 1988).

The self-consistent phonon (SCP) theory is used to study the dynamics of monolayers of xenon, krypton, and methane adsorbed on graphite. Only the $\sqrt{3}$ x $\sqrt{3}$ solid phase is considered. It is shown that the phonon energies of the Xe monolayers are very similar to those of their floating counterparts, while the interaction of the Kr and CH_4 monolayers with the graphite significantly affects the phonon dispersion curves. The gap in the phonon dispersion curves at the center of the Brillouin zone is computed as a function of temperature. At a critical temperature, the gap goes spontaneously to zero and a transition from a locked-in commensurate phase to a floating phase takes place. This transition appears to

describe the commensurate to floating transition in CH_4 well. A simple model of the floating transition is compared to the full SCP calculations. The one-phonon dynamic form factor, including the cubic anharmonic term, and phonon lifetimes are also evaluated for Kr and CH_4.

15323 **Dynamics of solid neon monolayers.** Hakim, T.M.; Glyde, H.R. (Department of Physics, University of Delaware, Newark, Delaware 19716). *Physical Review [Section] B: Condensed Matter;* 37: No. 2, 984-992(15 Jan 1988).

The dynamics of two-dimensional solid neon is investigated within the self-consistent phonon theory. Phonon frequencies and lifetimes and the one-phonon dynamic form factor are evaluated as a function of temperature and lattice spacing in the self-consistent harmonic approximation with the cubic anharmonic term added. Two-dimensional solid neon is found to be highly anharmonic. It becomes mechanically unstable for interatomic spacing a = 3.35 A and larger at T = 0 K.

15324 **Excited-state absorption spectra of V/sup 2+/ in $KMgF_3$ and MgF_2.** Payne, S.A.; Chase, L.L.; Wilke, G.D. (Lawrence Livermore National Laboratory, University of California, P.O. Box 5508, Livermore, California 94550). *Physical Review [Section] B: Condensed Matter;* 37: No. 2, 998-1006(15 Jan 1988). Contract W-7405-ENG-48.

We have measured the excited-state absorption spectra of V/sup 2+/ in $KMgF_3$ and MgF_2. The observed absorption bands can be identified as being due to the $^4T_2 \rightarrow {}^4T_1$a and $^4T_1$b transitions. The position and shape of the $^4T_2 \rightarrow {}^4T_1$b transition are determined primarily by the displacement in the a_1/sub g/ mode while the coupling of the orbital triplet states to e/sub g/ distortions is found to have a substantial influence on the nature of the $^4T_2 \rightarrow {}^4T_1$a transition. In fact, this transition is observed as a broad band rather than as a sharp line, as is predicted solely on the basis of the a_1/sub g/ coordinate. The $^4T_2 \rightarrow {}^4T_1$a transition is shifted up in energy relative to its predicted position and significantly overlaps the emission spectrum, thereby providing an explanation for the poor lasing efficiency reported for V/sup 2+/ lasers.

15325 **Implanted nitrogen in germanium.** Stein, H.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* 52: No. 2, 153-154(11 Jan 1988).

The first measurements of localized vibrational modes for N in crystalline Ge are reported. Nitrogen isotopes were implanted into Ge, and infrared absorption measurements were made at 80 K after laser annealing. Four isotopic mass-shifted infrared absorption bands are observed. Two of the bands in Ge are analogous to those for N pairs in crystalline Si and are assigned to N pairs in Ge.

15326 **High-temperature stability of Nb/GaAs and NbN/GaAs interfaces.** Ding, J.; Lee, B.; Gronsky, R.; Washburn, J.; Chin, D.; Van Duzer, T. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Applied Physics Letters;* 52: No. 2, 135-137(11 Jan 1988). Contract AC03-76SF00098.

The interface stabilities of Nb/GaAs and NbN/GaAs contacts at temperatures up to 700 °C for Nb/GaAs and 850 °C for NbN/GaAs have been investigated by transmission electron microscopy and x-ray diffractometry techniques. Results reveal that a Nb/GaAs reaction takes place at temperatures above 600 °C, and interdiffusion at the NbN/GaAs interface occurs at temperatures above 800 °C. The correlation between the observed interface morphologies before and after annealing and previously reported electrical properties of these contacts is also discussed.

15327 **Geometric and local electronic structure of Si(111)-As.** Becker, R.S.; Swartzentruber, B.S.; Vickers, J.S.; Hybertsen, M.S.; Louie, S.G. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review Letters;* 60: No. 2, 116-119(11 Jan 1988).

The Si(111)-As surface is imaged by scanning tunneling microscopy under UHV conditions. A threefold-symmetric 1 x 1 structure is observed, consistent with models suggesting substitution of As for Si in the outer half of the top double layer. No evidence for residual stacking faults on the scale of the 7 x 7 mesh is detected, but atomic debris, interpreted as displaced Si atoms, is seen. I-V characteristics of the junction show features separated by 1.9—2.3 eV consistent with an empty surface state in the projected gap and a filled state resonance with the bulk as predicted by self-energy calculations for this surface.

15328 **Comment on "Determination of interface states for CaF_2/Si(111) from near-edge x-ray-absorption measurements".** Chen, C.T.; Sette, F. (AT&T Bell Laboratories, 600 Mountain Avenue, Murray Hill, New Jersey 07974). *Physical Review Letters;* 60: No. 2, 160-160(11 Jan 1988).

A Comment on the Letter by F. J. Himpsel, et al., Phys. Rev. Lett. 56, 1497 (1986).

15329 **Resonant, dispersive optical tuning in an epitaxial (Al,Ga)As Fabry—Perot etalon.** Gourley, P.L.; Drummond, T.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* 52: No. 1, 7-9(4 Jan 1988). Contract AC04-76DP00789.

We report optical tuning (an optically induced shift of the transmittance peak) of an epitaxial Fabry—Perot etalon comprising AlAs/AlGaAs quarter-wave high reflectors surrounding a GaAs/AlGaAs multiple quantum well spacer layer. The reflectors and spacer were produced in a single growth process by using molecular beam epitaxy. Low-power cw reflection and trasmittance spectra as well as higher power pulsed trasmittance spectra were measured at room temperature. A very sharp (~20 A full width at half-maximum) Fabry—Perot transmittance peak was observed near the resonant exciton wavelength (8500 A) at room temperature. The tuning of this transmittance mode under pulsed optical excitation is as large as 27 A. These results indicate that very large on/off switching ratios (~10:1) can be achieved with these structures.

15330 **Diffraction-derived spontaneous polarization in lithium sulfate monohydrate at 80 and 298 K.** Karppinen, M.; Liminga, R.; Kvick, A.; Abrahams, S.C. (Institute of Chemistry, University of Uppsala, Box 531, S-75121 Uppsala, Sweden). *Journal of Chemical Physics;* 88: No. 1, 351-355(1 Jan 1988).

The principal axes of the sulfate ion minimum-equipotential contact surface with respect to its charge center, and the charge and electric dipole moment distribution in the sulfate ion and in the water molecule, are derived for $Li_2SO_4xH_2O$ on the basis of previously determined net atomic charges [J. Chem. Phys. 85, 5221 (1986)]. The sulfate ion has a nonzero dipole moment of about 2.3 x 10^{-30} C m at 80 K that rotates 9° in the crystallographic a,c plane between 298 and 80 K. The dipole moment of the water molecule increases from about 6.7 x 10^{-30} C m at 298 K to 7.8 x 10^{-30} C m at 80 K, as it rotates 3.6° in the b,c plane. The total spontaneous polarization at 298 K is calculated to be 3.19(62) x 10^{-2} C m^{-2}, and at 80 K it is 4.37(51) x 10^{-2} C m^{-2}, along the positive direction of the polar axis. The sense and magnitude of the resulting calculated 1.18 x 10^{-2} C m^{-2} polarization change compare well with the experimental value of 1.04 x 10^{-2} C m^{-2} measured on heating through the same temperature interval. Determination of the absolute polarity of a $Li_2SO_4xH_2O$ crystal shows that the p_3-pyroelectric and the d_{33}-piezoelectric coefficients are both negative, indicating that similar dipole rotations occur in each, respectively, on heating and under tensile stress.

15331 **High dose Fe implantation of graphite at elevated temperature.** Lusnikov, A.; Ohana, I.; Dresselhaus, M.S.; Withrow, S.P. (Center for Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Journal of Applied Physics;* 63: No. 1, 195-197(1 Jan 1988).

Highly oriented pyrolytic graphite samples have been implanted at elevated temperature (450 °C) with ^{57}Fe species at high fluence (2 x 10^{17} cm^{-2}) and a bombarding energy of 35 keV. Under these conditions of implantation, materials with ferromagnetic properties have been synthesized, as demonstrated by magnetization measurements using a superconducting quantum interference device magnetometer. It is further shown that the samples exhibit ferromagnetic, paramagnetic, and diamagnetic contributions to the total

magnetization. The value of the measured coercive force and a comparison of scanning electron microscopy studies of the sample surface with the calculation of the saturation ferromagnetic moment suggest that fine iron particles are created on the surface. A mechanism is proposed to explain these observations. Complementary Rutherford backscattering spectroscopy and Raman measurements indicate that the lattice is not completely amorphized under these implantation conditions.

15332 **Phase transitions in a quasi-two-dimensional XY random magnetic system.** Katsumata, K.; Tuchendler, J.; Uemura, Y.J.; Yoshizawa, H. (The Institute of Physical and Chemical Research (RIKEN), Wako, Saitama 351-01, Japan). *Physical Review [Section] B: Condensed Matter;* **37**: No. 1, 356-369(1 Jan 1988).

The phase transitions of a randomly mixed quasi-two-dimensional antiferromagnet and ferromagnet Rb$_2$Mn/sub 1-//sub x/Cr/sub x/Cl$_4$ have been studied experimentally using ac susceptibility (chi), magnetization, and neutron scattering techniques. A characterization of the single crystals of Rb$_2$Mn/sub 1-//sub x/Cr/sub x/Cl$_4$ grown for this study is made with ac chi and electron-spin-resonance measurements. It turns out that the mixed system is a typical example of an XY magnet in the concentration range 0.1approx. $<x<1.0$. The concentration versus transition-temperature (x-T) phase diagram of this alloy under zero external magnetic field is constructed. The transition temperature from the paramagnetic (PM) to the antiferromagnetic phase decreases rapidly with increasing Cr concentration. A transition from the PM phase to the spin-glass (SG) phase is observed in the concentration region $0.34 \leq x < 0.5$. The mixed crystals with the concentrations $0.50 \leq x < 1.0$ show a reentrant spin-glass (RSG) transition; a sequence of transitions from the PM to ferromagnetic (FM) phase and from the FM phase to SG at a lower temperature. Qualitatively, the x-T phase diagram of Rb$_2$Mn/sub 1-//sub x/Cr/sub x/Cl$_4$ is explained by the theories on competing exchange interactions. The RSG transition is discussed in the context of recent theories on the two-dimensional XY spin glass.

15333 **Radiation stability and damage mechanisms in x-ray membranes.** Vladimirsky, Y. (Center for X-ray Optics, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **6**: No. 1, 183-185(Jan 1988). Contract AC03-76SF00098.

The radiation stability of x-ray membranes is of major importance for future development of x-ray lithography and x-ray microscopy. The primary concern in this respect is loss of dimensional stability due to the radiation damage. The dose required to introduce sensible distortion of the pattern on a membrane is far below that necessary for the radiolysis of the membrane material. The ability of a material to resist generation and accumulation of the radiation defects is related to its band structure. Mechanisms of radiation defect generation, protective mechanisms, and possible ways to control the radiation resistance are discussed.

15334 **Time-resolved continuum-edge-shift measurements in laser-shocked solids.** Bradley, D.K.; Kilkenny, J.; Rose, S.J.; Hares, J.D. (Imperial College, London, England). *Physical Review Letters;* **59**: No. 26, 2995-2998(28 Dec 1987).

The first measurement of the shift in position of the photoabsorption edge in a laser-heated and -shocked solid material are reported. A buried tracer layer is first radiatively heated to a few electron volts leading to the appearance of bound-bound transitions near to the K photoabsorption edge. Then as the shock runs through, the K edge shifts to lower energy ionizing the bound-bound transitions, in agreement with theory.

15335 **Half width of neutron spectra.** Cohen, E.G.D.; Westerhuijs, P.; de Schepper, I.M. (The Rockefeller University, New York, New York 10021). *Physical Review Letters;* **59**: No. 25, 2872-2874(21 Dec 1987).

We analyzed for the first time systematically the half-widths of a great variety of neutron spectra of simple dense classical fluids as functions of wave number and density. We find that the observed behavior of the half-width near its minimum value can be understood quantitatively on the basis of a generalization of a diffusion model, proposed before.

15336 **Interface formation of GaAs with Si(100), Si(111), and Ge(111): Core-level spectroscopy for monolayer coverages of GaAs, Ga, and As.** Bringans, R.D.; Olmstead, M.A.; Uhrberg, R.I.G.; Bachrach, R.Z. (Xerox Palo Alto Research Center, 3333 Coyote Hill Road, Palo Alto, California 94304). *Physical Review [Section] B: Condensed Matter;* **36**: No. 18, 9569-9580(15 Dec 1987).

The interface structure of thin overlayers of GaAs grown using molecular-beam epitaxy techniques on on-axis Si(100), Si(111), and Ge(111) substrates has been studied using photoemission core-level spectroscopy. Results for As and Ga overlayers are also reported and are utilized to interpret the results for GaAs growth. The interface bonding is found to be the same for growth using predeposition of Ga as for predeposition of As. For GaAs on Si(111), the bonding at the interface is found to consist predominantly of Si-As bonds. We also find strong evidence of island formation before the completion of the first GaAs bilayer. The total area between islands can be reduced either by faster deposition rates or by using a Ga prelayer. For GaAs on Si(100), bonding takes place to both Ga and As but with fewer Si-Ga bonds than Si-As bonds. The tendency to island formation is less than for the Si(111) case. These results are compared with earlier data for As interaction with off-axis Si(100) surfaces to explain the absence of antiphase domains in GaAs grown on off-axis (100) substrates. Roughly equal numbers of Ge-As and Ge-Ga bonds were found for GaAs on Ge(111), and this result is interpreted as indicating that Ge interdiffuses more rapidly into GaAs than does Si.

15337 **Excited-state photoionization of Ce/sup 3+/ ions in Ce/sup 3+/:CaF$_2$.** Pogatshnik, G.J.; Hamilton, D.S. (Department of Physics and Institute of Materials Science, University of Connecticut, Storrs, Connecticut 06268). *Physical Review [Section] B: Condensed Matter;* **36**: No. 16, 8251-8257(1 Dec 1987).

The formation of stable color centers in Ce/sup 3+/:CaF$_2$ is found to result from the optical pumping of the lowest 4f→5d absorption band of the Ce/sup 3+/ ions at C$_4$/sub v/ symmetry sites with a 308-nm excimer laser. Absorption spectra of these color centers indicate that they are Ce/sup 2+/ ions located at sites having O/sub h/ symmetry. The color centers are photochromic since they can be optically bleached. Measurements of the dependence of the number of photochromic color centers on the incident laser intensity and length of exposure are presented. The data is interpreted in terms of a two-step photoionization of the Ce/sup 3+/ ions and the subsequent electron capture at a Ce/sup 3+/ ion having O/sub h/ symmetry. Rate equations incorporating a two-photon creation term and a one-photon bleaching term are formulated and their solutions are consistent with the observed color-center growth kinetics. The implications of this work for other potential vibronic laser materials are also discussed.

15338 **Low-temperature properties of rare-earth and actinide iron phosphide compounds MFe$_4$P/sub 12/ (M = La, Pr, Nd, and Th).** Torikachvili, M.S.; Chen, J.W.; Dalichaouch, Y.; Guertin, R.P.; McElfresh, M.W.; Rossel, C.; Maple, M.B.; Meisner, G.P. (Department of Physics and Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, California 92093). *Physical Review [Section] B: Condensed Matter;* **36**: No. 16, 8660-8664(1 Dec 1987).

The low-temperature properties of MFe$_4$P/sub 12/ (M = La, Pr, Nd, and Th) single crystals have been studied by means of electrical-resistivity, magnetization, specific-heat, and magnetoresistivity measurements. Superconductivity among these compounds is known to occur only in LaFe$_4$P/sub 12/, which has a superconducting transition temperature T/sub c/ of ~4 K. The compounds PrFe$_4$P/sub 12/ and NdFe$_4$P/sub 12/ display features that suggest the occurrence of antiferromagnetic ordering below ~6.2 K and ferromagnetic ordering below ~2 K, respectively. Isothermal magnetization curves for PrFe$_4$P/sub 12/ below 6 K reveal a spin-flop or metamagnetic transition.

15339 **Pressure-dependent magnetism and electrical resistivity of UFe_4P/sub 12/.** Guertin, R.P.; Rossel, C.; Torikachvili, M.S.; McElfresh, M.W.; Maple, M.B.; Bloom, S.H.; Yao, Y.S.; Kuric, M.V.; Meisner, G.P. (Department of Physics and Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, California 92093). *Physical Review [Section] B: Condensed Matter;* 36: No. 16, 8665-8668(1 Dec 1987).

UFe_4P/sub 12/ is the first reported uranium-based ferromagnetic semiconductor. The Curie temperature T/sub C/ is 3.15 K, and the spontaneous magnetic moment σ_0 which at T = 1.14 K was found to be $\simeq$1.0 μ/sub B//(U atom), is associated entirely with the uranium ions. The electrical resistivity rho(T) increases by nearly 7 orders of magnitude as temperature is decreased from room temperature to 4.2 K. The behavior of the ferromagnetic and electrical properties of UFe_4P/sub 12/ in hydrostatic pressures up to 16 kbar is reported. Quasihydrostatic-pressure effects on rho(T) to 100 kbar are also reported. Although T/sub C/ increases sharply with increasing pressure at the rate dT/sub C//dP = 0.26 K/kbar (in contrast to similar data on the isomorphic ferromagnet $NdFe_4P$/sub 12/, where dT/sub C//dP = 0.03 K/kbar), σ_0 decreases, $(1/\sigma_0)(d\sigma_0/dp)$ = -0.007 kbar/sup -1/. Hydrostatic and quasihydrostatic pressure have little effect on rho(T).

15340 **Nonlinear optical studies of semiconductor interfacial properties.** Robinson, J.M.; Richmond, G.L. (University of Oregon, Eugene, OR 97403). *AIP (American Institute of Physics) Conference Proceedings;* 160: No. 1, 490-492(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

Second harmonic generation from amorphous selenium thin films and single crystal transition metal dichalcogenides under ambient conditions is reported.

15341 **Photoreflectance spectra for conducting polymer P3MT.** Yuan Ren-Kuan; Shen Xue-Chu; Tomkiewicz, M.; Ginley, D.S. (Department of Physics, Nanjing University). *Wuli Xuebao;* 36: No. 9, 1161-1168(Sep 1987). (In Chinese).

We report here the photoreflectance spectra of the conducting polymer. The interband transition and the transition associated with bipolaron have been observed for the poly (3-methyl thiophene)-P3MT with different doping densities and under different temperatures, different intensities of modulation light. It was also demonstrated experimentally that the bipolaron may be induced by light with photon energy larger than the band gap E/sub g/ of the material, the bipolaron is the intrinsic elementary excitation state which is independent on the way of inducement (photoinduced or doping-induced); bipolaron may be pinned by ionized impurity and then the confinement parameter will be increased.

15342 **Theory of eutectic growth under rapid solidification conditions.** Trivedi, R.; Magnin, P.; Kurz, W. (Ames Lab. USDOE and Dept. of Materials Science and Engineering, Iowa State Univ., Ames, IA 50011). *Acta Metallurgica;* 35: No. 4, 971-988(Apr 1987). Contract W-7405-ENG-82.

The Jackson-Hunt model of eutectic growth at small undercoolings is extended to large undercooling values which are commonly encountered under rapid solidification conditions. The parameters, λ/sup 2/V and $\lambda\Delta T$, are found to deviate from constant values at high velocities, and these deviations depend upon the nature of the metastable phase diagram below the eutectic temperature. A limiting velocity is predicted for the formation of a regular, coupled eutectic structure, and the reason for this limiting velocity is shown to be either the temperature dependent diffusion coefficient or the limit of undercooling.

15343 **Retardation of annealing embrittlement in iron-based glasses by microaddition of cerium.** Kroeger, D.M.; Canright, G.S.; McKamey, C.G.; Easton, D.S.; Scarbrough, J.O. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN 37831). *Acta Metallurgica;* 35: No. 4, 989(Apr 1987). Contract AC05-84OR21400.

The effects of microadditions of cerium on the rate of annealing embrittlement, stress relief, and as-quenched magnetic domain structure in three iron-based metallic glasses have been investigated. Ribbons melt-spun from optimally doped castings of composition Fe/sub 80/B/sub 16/Si/sub 2/C/sub 2/ and Fe/sub 80/B/sub 20/ did not embrittle during annealing until the onset of crystallization, whereas Fe/sub 78/B/sub 13/Si/sub 9/ ribbons were unaffected by cerium additions. The authors conclude that annealing embrittlement in the first two glasses is an impurity effect, and that the embrittling impurities are oxygen and/or sulfur, the dissolved concentrations of which are strongly reduced by cerium additions. That low concentrations (50-100 at. ppm) of these impurities are sufficient to cause annealing embrittlement suggests that impurity segregation may be involved in the embrittlement process.

15344 **Multiple quantum NMR study of hydrogen clustering in amorphous silicon.** Gleason, K.K.; Baum, J.; Garroway, A.N.; Pines, A.; Reimer, J.A. (Dept. of Chemical Engineering, Univ. of California, Berkeley, CA 94720). pp 83-88 of Materials issues in amorphous semiconductor technology. Adler, D.; Hamakawa, Y.; Madan, A. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Because Multiple Quantum NMR coherences occur only between spins which are coupled together by the dipole interaction, this technique has been used to study the clustering of hydrogen in amorphous silicon. The clustered hydrogen was found to be associated with the broad line of the single quantum NMR spectra. For device quality films, the average cluster size is approximately six protons. The concentration of these five to seven atom defects increases with increasing hydrogen content until, at very high hydrogen content, the clusters are replaced by a continuous network of silicon-hydrogen bonds.

15345 **Microcrystallinity in α-Si,Ge:H,F alloys.** Shen, D.S.; Kolodzey, J.; Slobodin, D.; Conde, J.P.; Lane, C.; Campbell, I.H.; Fauchet, P.M.; Wagner, S. (Dept. of Electrical Engineering, Princeton Univ., Princeton, NJ 08544). pp 301-306 of Materials issues in amorphous semiconductor technology. Adler, D.; Hamakawa, Y.; Madan, A. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Microcrystalline inclusions in hydrogenated and fluorinated amorphous silicon-germanium alloys, α-Si,Ge:H,F, were studied. Microcrystals grown during RF or DC glow discharge deposition from SiF/sub 4/, GeF/sub 4/ and H/sub 2/ consist of either pure Si or Ge. Microcrystals produced by thermal annealing of initially amorphous alloys are either microcrystalline Ge or microcrystalline Si-Ge alloys depending on the annealing temperature. Values for the grain size were calculated from X-ray diffraction (XRD) and Raman spectra. The grain size of the "grown" microcrystal ranges from 8 to 60 nm. These grown grains exhibit preferential orientation of the (220) planes parallel to the substrate surface. Microcrystals produced by high-temperature anneal are randomly oriented. Scanning electron micrographs of as-grown samples show protruding platelets several 100 nm long and several 10 nm wide. Fractured cross sections exhibit columnar structure.

15346 **Deuteron magnetic resonance in a-Si and a-SiGe produced from fluorides.** Bork, V.P.; Fedders, P.A.; Norberg, R.E.; Leopold, D.J.; Mackenzie, K.D.; Paul, W. (Washington Univ., St. Louis, MO 63130). pp 307-312 of Materials issues in amorphous semiconductor technology. Adler, D.; Hamakawa, Y.; Madan, A. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Deuteron magnetic resonance line shapes and spin lattice relaxation times are presented for a-Si:D,F, and a-SiGe:D,F. These parameters differ from those for typical a-Si:D,H samples, but in some respects are similar to those for an annealed a-Si:D,H sample. The a-SiGe:D,F spectra display an unusually large broad central weakly bound D resonance component and a barely-resolved Ge-D quadrupolar doublet. Comparisons indicate substantial differences in void morphology between the a-Si:D,F and a-SiGe:D,F.

15347 **A comparative study of hydrogenated amorphous silicon films prepared by rf sputtering in He/H/sub 2/, Ar/H/sub 2/ and Xe/H/sub 2/ mixtures.** Albers, M.L.; Shanks, H.R.; Shinar, J. (Ames Lab.-USDOE and Dept. of Physics, Iowa State Univ., Ames, IA 50011). pp 59-64 of Materials issues in amorphous semiconductor technology. Adler, D.; Hamakawa, Y.; Madan, A. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract W-7405-ENG-82.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Preliminary results of a comparative study of some optical and ESR properties of aSi:H films prepared by rf sputtering on a cold substrate in 10 mtorr of either He, Ar, or Xe and 0.5 mtorr H/sub 2/ are presented. In all cases the concentration of Si-H and Si-H/sub 2/ bonds, the optical gap and the dangling bond spin density all generally increase as the rf power is decreased from 3.3 to 0.27 W/cm/sup 2/. However, whereas the optical energy gap of He/H/sub 2/ sputtered films ranges from 1.26 eV to 2.13 eV, the gap of Ar/H/sub 2/ and Xe/H/sub 2/ films sputtered under these conditions only changes from 1.54 to 1.94 and 1.41 to 1.71 eV, respectively. The dangling bond spin densities are lowest (—10/sup 17/cm/sup -3/) in the Ar/H/sub 2/ sputtered films at high rf power and highest (—5 x 10/sup 18/ cm/sup -3/) in Xe/H/sub 2/ sputtered films at low power.

15348 **The origin of slow states at the interface of a-Si:H and silicon nitride.** Street, R.A.; Tsai, C.C. (Xerox Palo Alto Research Center, Palo Alto, CA 94304). pp 367-372 of Materials issues in amorphous semiconductor technology. Adler, D.; Hamakawa, Y.; Madan, A. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Transient photoconductivity is used to investigate the origin of slow states near the interface of a-Si:H and silicon nitride. A graded composition of the nitride layer near the interface greatly increases the density of slow states. The authors deduce that slow states are bulk nitride traps and that the magnitude of charge storage is largely determined by the composition dependence of the localization radius of electrons within these traps. The kinetics of charge storage and release are found to be very different and are interpreted in terms of an activation step at the interface.

15349 **Material characterization and testing.** Carpinteri, A.; Ingraffea, A.R. Hingham, MA; D. Reidel Publishing Co. (1984). 214p. D. Reidel Publishing Co., 190 Old Derby St., Hingham, MA 02043.

This volume on concrete fracture addresses three main subjects. Firstly, a comprehensive literature review serves as a springboard for discussions and future investigations, and focuses on some, as yet unanswered, issues. The following three chapters present alternative view-points in the influence of microcracking on common measures of strength and deformability. They connect microstructural phenomena to macroscopic models and ultimately predict the relationship between microstructural changes and the resistance of concrete to cracking. The final two chapters survey the problem of experimental techniques for quantifying the fracture process in concrete.

40 CHEMISTRY

REFER ALSO TO CITATION(S) 17189

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 13946, 14098, 14148, 14157, 14159, 14161, 14167, 14170, 14195, 14346, 14351, 14357, 14436, 14531, 15285, 15445, 15467, 15468, 15495, 15509, 15648, 15833, 16013, 16014, 16080, 16092, 16423, 16452, 17264

15350 **(AEEW-R—2030) Review of analytical techniques to determine long-lived radiobiologically significant nuclides in encapsulated waste.** Amey, M.H.D.; Kenward, D.; Symons, W.J. (UKAEA Atomic Energy Establishment, Winfrith). May 1985. 42p. (ILWRP—85-P22). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750898/JAW.

Methods have been identified, or are proposed for, most of the radionuclides considered important for long term storage. From the information obtained the development of liquid chromatography together with an in-line radiochemical detector is proposed as a powerful technique for sequential separation and analysis of multi-component systems.

15351 **(AERE-M—3540) Isotope dilution and inductively coupled plasma mass spectrometry.** Long, S.E. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Apr 1986. 14p. H.M. Stationery Office, London, price $4.00.

The salient features of the technique of stable isotope dilution mass spectrometry (IDMS) are considered, with particular reference to its application using inductively coupled plasma mass spectrometry (ICPMS). The technique has been used for the determination of trace levels of cadmium in soil extracts and a BASIC computer program presented to assist in calculation of results when using ICPMS.

15352 **(AERE-R—11499) Atomic absorption spectrophotometry system for the analysis of radioactive samples, and its use for Tc determination in radioactive waste leachates.** Pollard, P.M.; McMillan, J.W.; Bowen, J.L.; Buckley, L.C.; Arthur, J.P.; McCullough, T. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.; UKAEA Atomic Energy Research Establishment, Harwell. Engineering Projects Div.). May 1986. 23p. H.M. Stationery Office, London, price Pound 4.75.

An atomic absorption spectrophotometer has been adapted for the examination of radioactive materials. A glove box has been designed and constructed to accommodate an electrothermal atomiser with an automatic sample changer, or a hydride generator. The atom reservoirs are optically coupled to the spectrophotometer in the open laboratory. The design philosophy, including special safety features, are described in detail. Technetium hollow cathode lamps have been made to allow the determination of technetium in radioactive waste leachates.

15353 **(AERE-R—12151) Comparison of thin layer activation, electrical resistance and electrochemical techniques for corrosion monitoring in cooling water plant.** Asher, J.; Sugden, S.; Lawrence, P.F.; Williams, D.E.; Naish, C. (UKAEA Atomic Energy Research Establishment, Harwell. Nuclear Physics Div.; UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Jul 1986. 26p. H.M. Stationery Office, London, price Pound 5.25.

A development trial is described in which the performance of a thin layer activation (TLA) instrument probe for corrosion monitoring is compared with that of an electrical resistance probe and electrochemical probes on a water cooling plant. The resulting data are discussed in the light of the nature of the physical corrosion processes involved, and the comparative performance of these techniques is assessed.

15354 **(AERE-R—12193) Technique for determining the fission gas content of small samples of irradiated reactor fuel.** Clough, D.J.; Gouldstone, S.J.; Keep, R.H.; Small, G.J. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Jul 1986. 15p. H. M. Stationery Office, London, price Pound 4.00.

The paper concerns the apparatus which measures the inventory of fission gases in small samples extracted from irradiated fuel pellets. The design, construction and recent refinements to the apparatus are described, along with a step-by-step operating sequence for easy reference. An assessment is made of the accuracy of the techniques and some typical results are given. The relative merits and disadvantages of this technique are outlined.

15355 **(BAR-IS—324) Pottery from Petra. A neutron activation analysis study.** Arnr, K. (B.A.R. Ltd., Oxford (UK)). 1987. 332p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The paper presents a PHd thesis on the pottery excavated in Petra between 1958 and 1964, using neutron activation analysis. Neutron activation analysis is a very sensitive method for detecting trace elements in various materials, and it thus can differentiate between clay sources in the pottery. One of the aims of the excavations was to establish the local, Nabataean, pottery types. The thesis contains chapters on: historical background, samples of Petra excavations, neutron activation analysis, and the data analysis.

15356 **(CEA-CONF—8999) Determination of heavy hydrogen isotopes by nuclear microprobe.** Trocellier, P.; Ducroux, R. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Aug 1986. 14p. (In French). (CONF-8608121—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751326/JAW.

From 11. international congress on X-ray optics and microanalysis; London, Canada (4 Aug 1986).

Microanalysis by direct observation of non resonant nuclear reactions allows to locate deuterium and tritium on solid materials surface. Energy spectrum of particles emitted by /sup 2/H(d,p) / sup 3/H and /sup 3/H(d,n)/sup 4/He reactions induced by a deuton microbeam of 300 to 600 keV give superficial distribution and concentration profile in function hydrogen isotope deepness.

15357 **(CEA-CONF—9067) Oceanic krypton 85: measurement technique and interest for oceanography.** Jean-Baptiste, P.; Andrie, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Jun 1987. 3p. (In French). (CONF-870627—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751546/JAW.

From International symposium on radioactivity and oceanography; Cherbourg, France (2 Jun 1987).

Published in summary form only.

15358 **(CEA-CONF—9068) Tritium determination by mass spectrometric analysis of helium 3 daughter product.** Jean Baptiste, P.; Andrie, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Jun 1987. 3p. (In French). (CONF-870627—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751547/JAW.

From International symposium on radioactivity and oceanography; Cherbourg, France (2 Jun 1987).

Published in summary form only.

15359 **(CEA-R—5401) Contribution to depth profiling by particle induced X-ray emission application to the study of zinc diffusion in AgZn alloy.** Frontier, J.P. (Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1987. 124p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751728/JAW.

A contribution of the study of the capacities of Particle Induced X-ray Emission (P.I.X.E.) for depth profiling, in the range of 1 to 10 micrometers and over, is presented here. It is shown that, in a non destructuve way, the concentration profile of a given element can be obtained, in principle, by deconvoluting the X-ray yields of this element, measured in a set of experiments in which the energy of the impinging protons, hence their range, is systematically varied. Direct deconvolution procedure, which leads to the inversion of an ill-conditionned matrix is unsuitable. So we generalized the iterative procedure previously used by Vegh to solve a similar problem. Alternatively we also used a fitting procedure of several parameters which gave us somewhat better than those of the iterative procedure. Both algorithms where applied to a set of X-ray yields induced by protons of energy between 0.45 to 2 MeV, corresponding to the first 6 micrometers of various depletion profiles of zinc in an initially homogeneous Ag-3 at % Zn annealed under vacuum. For investigation of deeper layers, a sectioning technique which consists in analysing thin film hydroxide targets by specific chemistry of tiny turning, was developed with success. Cross-reference of all the obtained profiles was made with electron microprobe determination on transverse section, and with the predictions of the theory of atomic diffusion. In addition, the possibilities of increasing the depth resolution by developping techniques either of controlled sanding of the surface, or analysis of the sample is discussed.

15360 **(DOE/ER/13189—3) Raman microprobe investigation of molecular structure and organization in the native state of woody tissue: Progress report for period July 1, 1986-June 30, 1987.** Atalla, R.H. (Institute of Paper Chemistry, Appleton, WI (USA)). Dec 1987. Contract FG02-84ER13189. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003985/JAW.

Efforts have been directed at understanding the sources of the luminescence which is encountered when plant tissue is exposed to laser excitation. The luminescence is one of the major obstacles to rapid acquisition of Raman spectra from such tissue. We are, therefore, developing procedures for limiting the interference of luminescence with acquisition of the spectra. We have established that the species contributing to luminescence in lignin rich samples differ from those dominant in purely cellulosic samples, and that the dominant luminescent processes are phosphorescent rather than fluorescent. We have also carried out a preliminary assessment of the utility of molecular oxygen as an alternative to water for quenching the luminescence during acquisition of the Raman spectra. 3 refs., 1 fig.

15361 **(DOE/ER/13357—10) Interfacial chemistry in solvent extraction systems: Progress report for period April 1, 1985-March 31, 1988.** Neuman, R.D. (Auburn Univ., AL (USA). Dept. of Chemical Engineering). Nov 1987. Contract FG05-85ER13357. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004095/JAW.

Interfacial behavior of extractant molecules and their interaction with metal ions has been investigated. Consideration was also given to the question of microscopic interfaces, i.e., those associated with reversed micelles as well as microemulsions. NMR spectroscopy, fluorescence spectroscopy, quasi-elastic light scattering, vapor pressure osmometry, and Karl-Fischer titrimetry provided support for findings obtained from interfacial tension experiments that reversed micelles are formed, under certain conditions, in the system di(2-ethylhexyl)phosphoric acid (HDEHP)/ n-hexane/$CaCl_2$ solution. These techniques were further extended to include different organophosphorus acids (PC 88A and CYANEX 272), diluent (benzene), and metal ions (Co^{2+}, Ni^{2+}, and Zn^{2+}) to determine whether reversed micellization occurs in solvent extraction systems which employ organophosphorus acids. A preliminary general model of the aggregation mechanism for metal-extractant complexes has been proposed. Also various laser techniques have been used to investigate the structure and dynamics of extractant films. A laser fluorescence apparatus for probing interfacial dynamics is under construction. 64 refs., 29 figs.

15362 (DOE/ER/60445—2) Identification of genotoxic components of the heavy ends of energy-related materials: Annual technical progress report, January 1, 1987-November 30, 1987. Lee, M.L.; Castle, R.N. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry; University of South Florida, Tampa (USA). Dept. of Chemistry). Dec 1987. Contract FG02-86ER60445. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004054/JAW.

Fourteen standard compounds were synthesized for use in determining compound types in coal-derived liquids. Capillary column gas chromatographhy/mass spectrometry was used to determine whether or not linked aromatic compounds were present in coal-derived liquids. Results indicate the possible presence of these compounds, but at extremely low levels (<0.05%). Therefore, a more direct approach to fractionating, separating, and identifying the heavy end fractions was pursued. Gel permeation chromatography was used to provide molecular weight fractions of an SRC II heavy distillate for analysis by supercritical fluid chromatography. The effects of addition of polar modifiers (propylene carbonate and dimethylformamide) on supercritical fluid solvating power were studied. These modifiers greatly increased the solvating power for large PAH, and will be useful in the application to heavy ends. The liquid crystalline polysiloxane stationary phase was shown to be effective in separating large PAH under supercritical conditions. Finally, a direct heated interface for coupling of a supercritical fluid chromatograph to a mass spectrometer was constructed and successfully evaluated. High molecular weight compounds were successfully analyzed under electron impact ionization conditions at the low nanogram level. 21 figs., 3 tabs.

15363 (ENEA-RT-TIB—85-5) Neutron activation analysis determination of trace elements in suspended particulate material and in central Thyrrenian sea sediments. Madaro, M.; Moauro, R.; Boniforti, R. (ENEA, Rome (Italy)). 1985. 25p. (In Italian). (CONF-8306304—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701274/JAW.

From 3. national meeting of radioecology; Bologna, Italy (22 Jun 1983).

Neutron activation analysis and gamma-spectrometry have been applied to the instrumental determination of 26 elements (As, Au, Ca, Ce, Co, Cr, Cs, Eu, Fe, Hf, Hg, La, Lu, Mn, Rb, Sb, Sc, Se, Sm, Ta, Tb, Th, W, Yb, Zn, Zr) in samples of suspended particulate matter and sediments collected in the stretch of Tyrrhenian Sea between the Volturno River mouth and the Cape of Circeo. Some of these elements have particular importance because they can be toxic to the organisms or can be used as tracers in the aquatic environment of radioisotopes generated in activation or fission processes. Results show that some elements, not constituting particular crystal lattices, are more concentrated in particulate matter than in sediments. Such results agree with the hypothesis, supported also by others, that particulate matter acts as a scavenger with respect to most microelements, because of both biological and physico-chemical phenomena.

15364 (EUR—10814) Characterization of uranium and plutonium reference materials by the (100-X) route; basic principle and applications. Verdingh, V.; Le Duigou, Y. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements; Commission of the European Communities, Luxembourg). 1986. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751592/JAW.

Uranium and plutonium reference materials are produced to calibrate reagents used in titrimetric methods or to check instrumental techniques like electrochemical methods. For this purpose, the most commonly prepared reference materials are high-purity uranium metal pieces and uranium dioxide pellets, respectively plutonium metal pieces and plutonium dioxide powders. Two different routes can be followed to certify the element content: a direct or an indirect route. With the direct route the main element is assayed using appropriate redox titration methods. The overall uncertainty on the main element is limited by both the precision of the titration methods used and the uncertainty of the reference materials. The indirect route is applicable only for high purity base material. It requires the measurement of the sum of impurities (X) in the material and the substraction of this sum from hundred per cent (100-X). Since the (100-X) route requires the measurement of a large number of elements, a variety of analytical methods has to be used, and a contribution by different specialized laboratories is requested. The uncertainty of the total of impurities is calculated from the respective uncertainties of the determination of each specific element. If the total of impurities is sufficiently small and even if it is determined with a rather large uncertainty, the (100-X) route leads nevertheless to a low uncertainty on the main element content. The application of the (100-X) route is illustrated for the case of uranium dioxide pellets certified as an European Community Nuclear Reference Material. The (100-X) route is recommended as a very accurate one for high purity material characterization and certification purposes.

15365 (EUR—10817) 1984 EC enquiry into the needs for nuclear reference materials (Z>89). Verdingh, V. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements; Commission of the European Communities, Luxembourg). 1987. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751593/JAW.

For years now, experts in the nuclear field have expressed and pointed out the widespread need for Nuclear Reference Materials (NRMs) in the whole of the nuclear fuel cycle. NRMs were defined as actinides with well-characterized chemical, isotopic and/or physical properties for use as a common base for the calibration of instruments and checking of analytical methods. Since nuclear energy from fission reactors is an increasing contributor to the electricity generating capacity in the EC, there is an equivalent demand for accurate analytical measurements in the various stages of the fuel cycle and in associated fields such as: commercial transactions, production control, nuclear material accounting (safeguards), waste disposal, environmental and health physics, research and development. An essential element for improving analyses and measurements is the availability and use of the appropriate NRMs.

15366 (IAEA-RL—148) Preparation and certification of IAEA gamma-ray spectrometry reference materials RGU-1, RGTh-1 and RGK-1. (International Atomic Energy Agency, Vienna (Austria)). Aug 1987. 48p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700178/JAW.

The IAEA noted a requirement for materials specifically designed for use in calibrating laboratory gamma-ray spectrometers used for the analysis of geological and uranium exploration samples. Following the recommendations of the Consultants' Group, arrangements were made with the CANMET, to undertake the preparation of a thorium and a uranium reference material to serve as IAEA AQCS certified reference materials. The result was the completion of RGU-1 and RGTh-1, which together with RGK-1, prepared by the AQCS, form a set of three materials for the calibration of laboratory gamma-ray spectrometers for potassium, uranium and thorium. The preparation of RGU-1, RGTh-1 and RGK-1 is described in this report.

15367 (IAEA-TECDOC—435) Comparison of nuclear analytical methods with competitive methods. Proceedings of an advisory group meeting held in Oak Ridge, 3-7 October 1986. (International Atomic Energy Agency, Vienna (Austria)). Oct 1987. 240p. (CONF-8610149—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW.

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

The use of nuclear analytical techniques, especially neutron activation analysis, already have a 50 year old history. Today several sensitive and accurate, non-nuclear trace element analytical techniques are available and new methods are continuously developed. The IAEA is supporting the development of nuclear analytical laboratories in its Member States. In order to be able to advise the developing countries which methods to use in different applications, it is important to know the present status and development trends of nuclear analytical methods, what are their benefits, drawbacks and recommended fields of application, compared with other, non-nuclear techniques. In order to get an answer to these questions the IAEA convened this Advisory Group Meeting. This

volume is the outcome of the presentations and discussions of the meeting. A separate abstract was prepared for each of the 21 papers. Refs, figs, tabs.

15368 (IAEA-TECDOC—435, pp 37-48) **Use of scientometrics to assess nuclear and other analytical methods.** Lyon, W.S. (Oak Ridge National Lab., TN, USA). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

Scientometrics involves the use of quantitative methods to investigate science viewed as an information process. Scientometric studies can be useful in ascertaining which methods have been most employed for various analytical determinations as well as for predicting which methods will continue to be used in the immediate future and which appear to be losing favor with the analytical community. Published papers in the technical literature are the primary source materials for scientometric studies; statistical methods and computer techniques are the tools. Recent studies have included growth and trends in prompt nuclear analysis impact of research published in a technical journal, and institutional and national representation, speakers and topics at several IAEA conferences, at modern trends in activation analysis conferences, and at other nonnuclear oriented conferences. Attempts have also been made to predict future growth of various topics and techniques. (author). 13 refs, 4 figs, 7 tabs.

15369 (IAEA-TECDOC—435, pp 59) **Plutonium isotopic measurements by gamma-ray spectrometry versus mass spectrometry.** Mayer, R.L.; Rakel, D.A. (Monsanto Research Corp., Miamisburg, OH, USA). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

For several years Mound has actively contributed to the development of the measurement of plutonium isotopic composition by gamma-ray spectrometry. This development effort has been conducted primarily in support of calorimetry and safeguards measurements. As part of this effort, Mound has participated in a number of sample exchange programs. For the Metals Exchange Program, Mound has reported the results of isotopic measurements obtained by nondestructive (gamma-ray spectrometry) and destructive (mass spectrometry and alpha counting) means. Comparisons of the recent performance of nondestructive and destructive isotopics measurements at Mound will be presented. In addition, the instrumentation required for data acquisition and analysis of gamma-ray spectrometry measurements and their benefits will be presented.

15370 (IAEA-TECDOC—435, pp 61-65) **Uranium determination by fission track counting.** Dyer, F.F. (Oak Ridge National Lab., TN, USA). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

To the analytical chemist, one of the most important aspects of nuclear tracks is the capability they give to quantitatively measure trace concentrations of alpha-emitting and fissile nuclides in matter. The procedure for determining /sup 235/U is simple in principle. A sample is packaged in a clean dust-free atmosphere in contact with a track recorder and irradiated in a neutron flux for a suitable time. The recorder is etched to make the tracks optically visible and the /sup 235/U concentration is estimated from the track density relative to the track density produced by a /sup 235/U standard similarly treated. The detection limit for natural uranium is comparable to that of isotope dilution mass spectrometry and neutron activation analysis and has been reported to be below 40 picograms per gram. The method can be applied to nearly all solids, including powders, and very little sample preparation is necessary. (author). 10 refs.

15371 (IAEA-TECDOC—435, pp 67) **Applications of Cerenkov counting: A useful technique for environmental radio-analyses.** Eldridge, J.S. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN, USA). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

15372 (IAEA-TECDOC—435, pp 69-82) **Comparison of isotope dilution analysis with other analytical techniques.** Toelgyessy, J.; Klehr, E.H. (Slovak Technical Univ., Bratislava, Czechoslovakia; Oklahoma Univ., Norman, USA). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

Isotope dilution analysis (IDA) is the most useful of the indicator radioanalytical methods, especially for elemental analysis. New concepts of IDA, such as substoichiometric and sub-superequivalence IDA, have improved the sensitivity and expanded the applicability of the method for trace analysis. IDA has been used for the analysis of biological and geological materials, water, soils, semi-conductors, etc. In this paper, IDA is compared to other analytical methods, in terms of concentration range, limit of detection, selectivity, time and cost. (author). 12 refs, 3 figs, 3 tabs.

15373 (IAEA-TECDOC—435, pp 89-103) **Application of the isotope exchange method of analysis to the speciative determination of phosphorus in environmental samples.** Ikeda, N. (Tsukuba Univ., Sakura, Ibaraki, Japan. Dept. of Chemistry). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

Speciative determination of phosphorus (PO/sub 4//sup 3-/, PO/sub 3//sup 3-/ and total P) in natural water samples can be achieved by using the reverse isotope exchange method. Five ml of a natural water sample is taken and dil. H/sub 2/SO/sub 4/ solution of ammonium molybdophosphate and a definite activity (a/sub 0/) of /sup 32/P (in PO/sub 4//sup 3-/ form) are added. The solution is shaken with the 1,2-dichloroethane solution of tetraphenylarsonium molybdophosphate which contains a definite amount of P (W/sub 1/). After the quickly attainable exchange equilibrium between phosphate in the aqueous phase and tetraphenylarsonium molybdophosphate in the organic phase, the activity of the organic phase (a/sub 2/) is measured. The amounts of P (W/sub x/) in the sample can be obtained by the equation of W/sub x/=(a/sub 0//a/sub 2/-1)W/sub 1/. In this condition, only PO/sub 4//sup 3-/ exchanges, while PO/sub 3//sup 3-/ does not. Therefore, PO/sub 4//sup 3-/ can be determined in the presence of PO/sub 3//sup 3-/ and unexchangeable phosphorus. When the sample water is treated with Br/sub 2/ water in advance, the amount of PO/sub 4//sup 3-/ + PO/sub 3//sup 3-/ can be obtained. When the sample is treated with H/sub 2/SO/sub 4/ and HNO/sub 3/, then the amount of total P can be obtained. The method is compared with the conventional spectrophotometric method (the molybdenum-blue method). This method is much simpler and more rapid, and moreover, the speciative determination is possible. (author). 13 refs, 2 figs, 6 tabs.

15374 (IAEA-TECDOC—435, pp 129-141) **Role of INAA as compared to conventional methods of analysis for geological samples in Canada.** Hoffman, E.L. (McMaster Univ., Hamilton, Ontario, Canada). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

The instrumental neutron activation analytical technique (INAA) both competes with and complements conventional commercial analytical methods like X-ray fluorescence emission spectrometry (XRF), direct coupled plasma emission spectrometry

(DCP), inductively coupled plasma emission spectrometry (ICP), inductively coupled plasma-mass spectrometry (ICP-MS) and atomic absorption (A.A.). The major advantages to the use of INAA in the geological field includes the fact that the analysis can be done non-destructively without encountering the many problems inherent in acid dissolution or fire assay techniques. The sensitivity for many elements are still unrivalled by commercially available analytical techniques for gold, platinum-group-elements, many of the rare earth elements and other elements. The multi-element nature of the analysis combined with ease of automation, data collection and spectral analysis procedures allows for rapid turnaround of samples at low cost. This technique competes very favourably with virtually all other analytical techniques. The geological market being served by INAA includes university and government researchers as well as the mineral exploration industry. The needs of these groups varies considerably and will be discussed. The various applications of INAA to the geological community will also be discussed. (author). 6 refs, 5 tabs.

15375 (IAEA-TECDOC—435, pp 143-144) **Determination of minor and trace elements in diets using neutron activation, inductively coupled plasma atomic emission and atomic absorption spectrometry.** Schelenz, R. (International Atomic Energy Agency, Vienna, Austria. Dept. of Research and Isotopes). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

15376 (IAEA-TECDOC—435, pp 147-162) **Present and future prospects for neutron activation analysis compared to other methods available.** Revel, G. (Laboratoire d'Analyse par Activation Pierre Sue, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

The evolution of analysis by Neutron Activation during the last fifty years is briefly described. The reasons for its persistent success, in spite of more recent methods are examined. These reasons are based on the specific advantages of neutron irradiation: neutron penetration into the material, sensitive detection of 60 elements, selectivity and reliability. Furthermore the sensitivity is inversely proportional to the natural abundance of the element (for A>80). However to benefit fully from the advantages of N.A.A., it is essential to study the potential sources of error inherent in each step of the analysis (sampling, preparation, calibration, irradiation, chemical separation, radioactive measurement, calculation and interpretation of the results). These risks are discussed and examples given. The principal areas in which the N.A.A. is being used more and more are ultra-traces analysis, studies on the multivariant correlation between elements and the validation of other methods. Based on present applications and the likely progress of this technique, its future prospects are discussed. (author). 30 refs, 2 figs, 8 tabs.

15377 (IAEA-TECDOC—435, pp 163-178) **Comparison of 14 MeV neutron activation analysis and competitive methods for determination of oxygen, nitrogen, silicon, fluorine and other elements.** Bild, R.W. (Sandia National Labs., Albuquerque, NM, USA). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

14 MeV neutron activation analysis (14 MeV NAA) makes use of small particle accelerators to produce 14 MeV neutrons from the D-T reaction. The neutrons produce radioactive isotopes in samples by the reactions (n,p), (n,2n) and (n,α). Gamma rays emitted are counted to determine the amount of the target element present. Major applications have been determination of total O, N or Si in solid and liquid matrices, but the technique can also be applied to determine concentrations of about 30 other elements including F, Cl, Al, P and Mg. Detection limits are a few micrograms in the best cases and milligrams for most others. The method has advantages of being nondestructive, fast and insensitive to sample inhomogeneities. It lends itself especially well to sequential analysis of the same sample by several techniques and to samples that are difficult to dissolve. Portable generators have been applied to industrial situations and to well logging. Major disadvantages are the necessity to house a radiation producing instrument, the cost of the equipment and the lack of useful neutron reactions for some important elements. Accuracy (typically +-1 to 10% relative) and precision (+-1 to 5% relative) are comparable to competing techniques. For determination of low levels of O and N in most metals inert gas fusion is more rapid and sensitive; elemental analyzer is more sensitive for O and N in organics. Wet chemical methods rarely have any advantage over 14 MeV NAA for solid samples when concentrations are in the detection limit range of the 14 MeV NAA methods. Future developments in the field will come in the areas of simpler, more portable and higher neutron output generator designs. (author). 66 refs.

15378 (IAEA-TECDOC—435, pp 179-186) **Nuclear analytical methods at NTT Electrical Communications Laboratories. Substoichiometric analysis and its applications.** Shigematsu, T. (Nippon Telegraph and Telephone Corp., Tokai, Ibaraki, Japan. Electrical Communications Labs.). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

This paper describes the nuclear analytical methods that are used at NTT Electrical Communications Laboratories. In particular, it focuses on the use of the activation method in substoichiometric analysis and its applications. The accuracy and precision of substoichiometric analysis are investigated by considering the effects on systematic and accidental errors caused in analytical procedures. It is shown that the total errors of substoichiometric analysis are dominated by statistical fluctuations in activity measurements. It is also shown that substoichiometric analysis is one of the most accurate analytical methods. This is useful in the characterization of electrical materials and devices and in the standardization of other analytical methods. (author). 3 refs, 9 figs.

15379 (IAEA-TECDOC—435, pp 187-193) **Nuclear analytical methods in standards certification.** Lindstrom, R.M. (National Bureau of Standards, Gaithersburg, MD, USA). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

Nuclear methods of chemical analysis have played a prominent role in the accurate determination of the composition of Standard Reference Materials and other standards. The characteristic sensitivity, multielement capability, and freedom from chemical biases unique to nuclear methods assure them a continuing role in the standards laboratory. (author). 31 refs.

15380 (IAEA-TECDOC—435, pp 195-199) **Analysis of difficult materials: Comparison of nuclear and non-nuclear methods.** Pickford, C.J.; Hislop, J.S. (UKAEA Harwell Lab. Environmental and Medical Science Div.). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

In a laboratory analysing large numbers of dissimilar samples, of a routine and non-routine nature, the analytical procedures used for inorganic constituents must be chosen carefully. No single procedure is able to satisfy fully the analytical requirements for certain complex materials, and a combination of techniques must be used. The quality of data required must be weighed carefully against the performance characteristics of the individual techniques, and the economic resources which are available for the solution of the problem. Some examples of this approach are given, drawn

from the analysis of alloys, biological materials and fuel ashes. (author). 9 refs, 3 tabs.

15381 (IAEA-TECDOC—435, pp 201-211) **Trace element analysis in biological materials: A comparison of neutron activation analysis with other techniques, especially atomic spectroscopy.** Schramel, P. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg, Germany, F.R. Inst. fuer Oekologische Chemie). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

The analytical chemistry laboratory of GSF is concerned with trace element analysis mainly in connection with life sciences. It analyses annually 20,000 samples with an average of 20 elements per sample. Several different analytical techniques, including neutron activation analysis and non-nuclear methods are available. The paper discusses the advantages and disadvantages of the different analytical techniques as applied to biological and environmental samples.

15382 (IAEA-TECDOC—435, pp 213-217) **Development of activation analysis in China.** Xinhua, T. (Ministry of Nuclear Industry, Beijing, China. Bureau of Nuclear Fuels). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

Since the first nuclear research reactor and accelerator was built in 1958 activation analysis methods have been developed and applied in China. Four national activation analysis symposiums have been held. More than 200 papers on activation analysis have been published. The paper gives a review of applications. A miniature research reactor, MNSR, designed for neutron activation analysis is described. (author). 7 refs.

15383 (IAEA-TECDOC—435, pp 219-230) **Neutron activation analysis of geological samples in free competition - A case history from Finland.** Rosenberg, R.; Lipponen, M.; Vaenskae, L. (Technical Research Centre of Finland, Espoo. Reactor Lab.). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

At the Reactor Laboratory neutron activation analysis (NAA) of geological samples is performed on an analytical service basis. The expenses of this activity is expected to be covered by the income. Methods and automatic analyzers have been developed for the low cost analysis of large numbers of samples. During the period 1973-1979, 20,000-30,000 uranium determinations were made annually. During the period 1982-85 more than 10,000 samples were analyzed annually for gold and 23 other elements. The performance and cost of NAA compared with competitive methods are discussed. (author). 5 refs, 2 figs, 3 tabs.

15384 (IAEA-TECDOC—435, pp 9-35) **Statistical evaluation of recorded knowledge in nuclear and other instrumental analytical techniques.** Braun, T. (Eoetvoes Lorand Tudomanyegyetem, Budapest, Hungary. Szervetlen es Analitikai Kemiai Intezet). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

The main points addressed in this study are the following: Statistical distribution patterns of published literature on instrumental analytical techniques 1981-1984; The structure of scientific literatures and heuristics for identifying active specialties and emerging hot spot research areas in instrumental analytical techniques; Growth and growth rates of the literature in some of the identified hot research areas; Quality and quantity in instrumental analytical research output. (author). 14 refs, 5 figs, 18 tabs.

15385 (IAEA-TECDOC—435, pp 49-56) **Comments on the establishment of a methodology for the metrological characterization of analytical methods.** Klehr, E.H.; Toelgyessy, J. (Oklahoma Univ., Norman, USA; Slovak Technical Univ., Bratislava, Czechoslovakia). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

For the comparison of analytical methods, it is important to use a standardized set of statistical techniques for the evaluation of data and for the comparison of methods. There seems to be some confusion regarding the definitions and calculations for basic terms such as accuracy, precision, detection limits, etc. Currently, these concepts do not have commonly accepted definitions or methods of calculation. It is proposed that we work toward the establishment of a common method of presenting such data, and a common method of its calculation. Only in this way will we be able to compare various analytical methods in a meaningful way. In this paper, a proposal is made for a unified methodology for the metrological characterization of analytical methods. (author). 5 refs, 4 figs.

15386 (IAEA-TECDOC—435, pp 83-88) **Contribution of radiotracers to the development of trace element analysis.** Krivan, V. (Ulm Univ., Germany, F.R. Sektion Analytik und Hoechstreinigung). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

This paper discusses applications of the radiotracers to methodological studies in trace element analysis. Owing to some unique features, the radiotracer technique has proved to be an indispensable means for examining the individual steps of an analytical procedure and revealing the concomitant sources of systematic error. In most cases, the radiotracer technique is the optimum approach, and some problems cannot be solved by other means. The examples discussed in more detail were taken from the analytical chemistry of mercury, sulphur, lead and selenium. The radiotracer investigations aimed at improving the accuracy of analytical procedures. (author). 16 refs, 6 figs, 1 tab.

15387 (IAEA-TECDOC—435, pp 105-116) **Resin bead methodology as applied to fuel burn-up and fissile inventories.** Smith, D.H.; Walker, R.L; Carter, J.A. (Oak Ridge National Lab., TN, USA). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

A new technique has been developed that allows acquisition of samples from matrices difficult to access. While the examples given in this paper are from the nuclear field, the technique is readily modified to address other areas. The technique involves obtaining samples on resin beads; each bead then comprises a sample for mass spectrometric analysis. Through the application of isotope dilution, concentrations of the target elements can be obtained in addition to their isotopic compositions. Examples of application of this technique are given for U, Pu, and Nd. (author). 19 refs, 3 figs, 3 tabs.

15388 (INIS-BR—910, pp 13) **Magnetic resonance of uranium a tool in nuclear power.** Ursu, I.; Lupei, V.; Demco, D. (Central Institute of Physics, Bucharest, Romania). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

15389 (INIS-BR—910, pp 98) **Multifrequency ESR of Cu (II) - (Histidine)n.** Basosi, R.; Froncisz, W.; Pasenkiewicz, M.; Antholine, W.E.; Hyde, J.S. (Siena Univ., Italy. Dipt. di Chimica; Dept. of Biophysics, Krakow, Poland; Medical Coll. of Wisconsin, Milwaukee, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

15390 (INIS-BR—910, pp 104) **2D-NMR of 3D-Structure of scorpion neurotoxin M9 Buthus eupeus.** Paskov, V.S.; Hoang, N.A.; Gavrilov, Y.D.; Shemyakin. (AN SSSR, Moscow. Inst. Bioorganicheskoj Khimii). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

15391 **(INIS-mf—10795) 13. seminar 'Activation analysis'. Summaries.** (Gesellschaft Deutscher Chemiker, Frankfurt am Main (Germany, F.R.). Arbeitskreis Radioanalytik). 1987. 25p. (In German). (CONF-8710240—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW.

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

Collection of the abstracts of contributions to the seminar covering broad ranges of application of activation analysis and improvements of systems and process steps. Most of them have been prepared separately for the energy data bases.

15392 (INIS-mf—10795, pp 2) **Determination of trace element impurities in the fabrication of silicon radiation detectors by means of the monostandard neutron activation analysis.** Boehm, G.; Henkelmann, R.; Kim, J.I. (Technische Univ. Muenchen, Garching, Germany, F.R. Inst. fuer Radiochemie). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15393 (INIS-mf—10795, pp 4) **Activation analytical determination of chlorine, manganese, and iodine contents of contact material and reaction mixtures from a vinyl-acetate production plant.** Fuchs, H.J.; Lux, F. (Technische Univ. Muenchen, Garching, Germany, F.R. Inst. fuer Radiochemie). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15394 (INIS-mf—10795, pp 5) **Determination of thallium in zinc by means of proton activation analysis.** Brucker, N. de; Strijckmans, K.; Dams, R.; Hoste, J. 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15395 (INIS-mf—10795, pp 6) **Single-comparator method in thermal neutron activation analysis extended for some (n,p)-reactions.** Verheijke, M.L.; Jansen, R.M.W. (Philips Research Labs., Eindhoven, Netherlands). 1987. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15396 (INIS-mf—10795, pp 7) **Investigation of chemical surface modification by the use of bromine as a tracer element.** Jaspers, H.J.J.; Hanssen, J.M.G. (Philips Research Labs., Eindhoven, Netherlands). 1987. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15397 (INIS-mf—10795, pp 8) **Activation analysis of low phosphorus contents in copper and aluminium.** Kueppers, G.; Erdtmann, G. (Kernforschungsanlage Juelich G.m.b.H., Germany, F.R. Zentralabteilung fuer Chemische Analysen). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15398 (INIS-mf—10795, pp 9) **Redetermination of the proportionality factor Y/sub OX/ in the determination of oxygen in silicon by infrared absorption.** Schmitt, B.F. (Bundesanstalt fuer Materialforschung und -pruefung, Berlin, Germany, F.R.). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15399 (INIS-mf—10795, pp 10) **Development and optimization of equipment and process steps in neutron activation analysis.** Erdtmann, G.; Gueldenberg, F.; Kaysser, B.; Kueppers, G.; Petri, H.; Rauschen, M. (Kernforschungsanlage Juelich G.m.b.H., Germany, F.R. Zentralabteilung fuer Chemische Analysen). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15400 (INIS-mf—10795, pp 13) **Precision of archaeometric studies of ceramics by neutron activation analysis.** Mommsen, H.; Ihmsen, H.; Kreuser, A.; Lewandowski, F.; Weber, J.; Winter, G. (Bonn Univ., Germany, F.R. Inst. fuer Strahlen- und Kernphysik). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15401 (INIS-mf—10795, pp 14) **Activation analysis of ceramics with cyclotron fast neutrons.** Ihmsen, H.; Kreuser, A.; Lewandowski, E.; Mommsen, H.; Weber, J.; Winter, G. (Bonn Univ., Germany, F.R. Inst. fuer Strahlen- und Kernphysik). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15402 (INIS-mf—10795, pp 15) **14 MeV neutron activation analysis of antique bronzes.** Tian, Y.; Pepelnik, R. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude, Germany, F.R. Inst. fuer Physik; Lanzhou Univ., Gansu, China. Dept. of Modern Physics). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15403 (INIS-mf—10795, pp 16) **Remarks on the nondestructive activation analysis of ancient coins.** Segebade, C.; Carter, G.F. (Bundesanstalt fuer Materialforschung und -pruefung, Berlin, Germany, F.R.; Eastern Michigan Univ., Ypsilanti, USA). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15404 (INIS-mf—10795, pp 21) **Study of trace and minor elements in phosphate fertilizers by means of instrumental neutron activation analysis.** Heiland, K.; Schnier, C.; Niedergesaess, R. 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15405 (INIS-mf—10795, pp 22) **Standardization of geologic reference samples for the application in instrumental neutron activation analysis.** Dulski, P. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H., Germany, F.R.). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15406 (INIS-mf—10795, pp 25) **Determination of the spallogenic /sup 53/Mn in meteorites by means of radiochemical neutron activation analysis.** Vogt, S.; Heppers, U.; Sarafin, R. (Koeln Univ., Germany, F.R. Abt. Nuklearchemie). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

15407 (INIS-mf—11093, pp 65-66) **Applications of statistical methods to test XPS measurements.** Koever, L.; Vegh, J.; Toth, J. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

15408 (INIS-mf—11093, pp 67-69) **Application of quadrupole mass spectrometer to industrial fermentation.** Bohatka, S.; Berecz, I.; Langer, G.; Szilagyi, J. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete; BIOGAL Gyogyszergyar, Debrecen, Hungary). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

15409 (IPEN-Pub—103) **Method for determination of Sr-90 Y-90 by using EDTA and ion-exchangers-Applications to the determination of those radioisotopes in milk.** Silva, C.M.; Lima, F.W. de. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). May 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700885/JAW.

A method in which the complex of ethylenediaminetetraacetic acid (EDTA) with yttrium, used in conjunction with ion-exchangers for determination of Sr-90 is described. The method was to the determination of concentration of Sr-90 in milk, avoiding, in this way, protein elimination by acid precipitation or by evaporation of milk and ashing the residue. Analysis of samples of milk from various places in the state of Sao Pa ulo, Brazil, were carried out and the results are reported. Values found are much lower than maximum permissible concentration.

15410 (IPEN-Pub—107) **Spectrochemical determination of impurities in zircaloy 2 and 4.** Paula Reino, L.C. de; Lordello, A.R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Jun 1987. 11p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700241/JAW.

A method has been developed for the determination of Hf,Co,Mo,Pb,Ti,V,Al,Si,W,Cu,Mg,Mn,B and Cd in zircaloy 2 and 4. For hafnium determination 10% CuF_2 is added as spectrographic buffer on a previously oxidized zircaloy; the samples are loaded in a shallow cup electrode of Scribner Mullins type and excited in a direct current arc. The carrier distillation technique has been used for the other elements. Better results were obtained with 25% AgCl as carrier. The precision of the method varies from 4% for copper to 29% for boron but it does not exceed 17% for most elements.

15411 (IPEN-Pub—108) **Determination of water in nuclear materials by means of the Karl Fischer method.** Pereira, W.; Rocha, S.M.R.; Atalla, L.T.; Abrao, A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Jun 1987. 10p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700242/JAW.

Karl Fischer Method was adapted for water determination in uranium coumpounds and substances of nuclear interest, by using a comercial equipment. The experimental conditions for the analysis of U_3O_8, UO_3, UO_2, UF_4,KFnHF and $(NH_4)_4UO_2(CO_3)_3$ were established. The influence of the agitation and contact time between sample and solvent, of the sample weight, of the reaction end point determination and of the sample granulometry on the precision and accuracy of results was also studied.

15412 (IPEN-Pub—109) **Separation of halogens from uranium compounds by means of pyrohydrolysis and their determination by ion chromatography.** Pires, M.A.F.; Brandao Filho, D.; Abrao, A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Jul 1987. 14p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700243/JAW.

This paper describs the determination of fluorine in nuclear grade uranium compounds by means of phyrohydrolysis. A stream of wet oxygem at a temperature of 900 to 1000°C is passed through a quartz tube where the powdered samples is put. The halogens are volatilized as their respective acids that are absorbed in a buffer solution or water. The measurements are made with ion-seletive eletrodes or by ion chromatography. The sensitivity is of 1μg F^-/g and 5μg Cl^-/g. The separation of fluorine from uranium compounds by diferent methods is discussed.

15413 (IPEN-Pub—115) **Determination of calcium and magnesium in nuclear grade alumina by ion chromatography technique.** Hespanhol, E.C.B.; Pires, M.A.F.; Atalla, L.T. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Jul 1987. 9p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700246/JAW.

A simple method for solubilization of alumina and separation of magnesium and calcium from alumina matrix was developed by initial coprecipitation of those elements with iron(III) hydroxide. Calcium and magnesium were later separated from iron chloride anionic complex in a Dowex 1-X 10 anionic exchange resin. The ion chromatography tecnnique was employed for the analysis of calcium and magnesium. One hundred percent recovery for calcium and magnesium was obtained in their separation from alumina. A precision of 6% and 10% for magnesium and calcium, respectively, was obtained in alumina samples analysis which contain less than 0,02% of magnesium and less than 0,08% of calcium.

15414 (IPNO-DRE—87-05) **Study of strontium extraction as cryptate complex in view to 102 element separation from the actinides.** Hussonnois, M.; Bruchertseifer, H.; Constantinescu, O.; Constantinescu, M. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751395/JAW.

In the present report is studied in detail the extraction of strontium, in tracer amounts, as cryptate and its separation from the lanthanides and transplutonium elements with a high degree of purification. Influence of different parameters: pH of the aqueous phase, cryptant concentration, counteranion concentration, nature of the solvent are investigated. It is intended to use this method to separate the 102 element from actinides in the study of the isotope /sup 102/ 259 produced in irradiation of a curium 248 target by oxygen 18 ions.

15415 **(Juel-Spez—393) Multi-element analysis for environmental characterization and its future trends.** Sansoni, B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung fuer Chemische Analysen). Apr 1987. 80p. (CONF-8611208—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751525/JAW.

From International symposium on new sensors and methods for environmental characterization (SMEC); Kyoto, Japan (10 Nov 1986).

Before starting to characterize the environment by its elemental composition, it may be useful to ask about the objective of these efforts. This includes questions about the scope of environmental protection, the definition of the environment and the limitations of its characterization by elemental composition alone. In the second part of this lecture, examples are given of the elemental composition of well analysed samples from the atmosphere, hydrosphere, lithosphere and biosphere. The third part introduces the principle of multi-element analysis and the fourth part gives examples. Finally, future aspects of modern chemical analysis are outlined with respect to the multi-element principle.

15416 **(LA—11114-MS) Quality assurance for health and environmental chemistry: 1986.** Gautier, M.A.; Gladney, E.S.; Moss, W.D.; Phillips, M.B.; O'Malley, B.T. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 347p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE88004753/JAW.

This report documents the continuing quality assurance efforts of the Health and Environmental Chemistry Group at the Los Alamos National Laboratory. The philosophy, methodology, and computing resources used by the quality assurance program to encompass the diversity of analytical chemistry practiced in the group are described. Included in the report are all quality assurance reference materials used, along with their certified or consensus concentrations, and all analytical chemistry quality assurance measurements made by HSE-9 during 1986. 27 refs., 3 figs.

15417 **(LA—11167) Determining zirconium in uranium by x-ray fluorescence.** Martell, C.J.; Hansel, J.M. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005089/JAW.

Various concentrations of zirconium in uranium are determined by dissolving 2.5 g of the uranium sample. We add an aliquot of sample solution plus the internal standard, yttrium, to a 10-ml volumetric flask and pour this solution into an x-ray cell that is covered with Mylar film. Standards and samples in x-ray cells are placed in an x-ray fluorescence wavelength instrument where the K/sub α/ line for both zirconium and yttrium are read. We then compare the ratio of the intensities of zirconium and yttrium for a sample with those for standards. The relative standard deviation for 1% and 5% zirconium is 0.6% and 0.08%, respectively, with an accuracy of 100.3%.

15418 **(LA-UR—87-4033) Overview of applications of Laser-Induced Breakdown Spectroscopy (LIBS).** Cremers, D.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-8711118—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004314/JAW.

From ICALEO '87: conference on electro-optic sensing and measurement; San Diego, CA, USA (8 Nov 1987).

Laser-induced breakdown spectroscopy (LIBS) is a method of performing elemental analyses of solids, liquids, and gases using the microplasma produced by a focused laser pulse. Because the microplasma is formed by optical radiation, LIBS has some important advantages compared to conventional laboratory based analytical methods. Three applications are discussed which use the LIBS method. 6 refs., 8 figs., 2 tabs.

15419 **(LYCEN-T—8632) Application techniques of alpha particles and heavy ion elastic scattering to chemical analysis of thin layers and surfaces.** Ziani, A. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). May 1986. 97p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751763/JAW.

This work turns to account two aspects of the elastic scattering: Rutherford or non-Rutherford backscattering of alpha particles for the study of the stoichiometry of complex thin layers and production of recoil nuclei under energetic argon ion (16-20 MeV) bombardment for the surface analysis of light elements like oxygen, nitrogen and carbon. The first section treats the analysis conditions of Ti/sub (1-x)/Nb/sub x/O/sub 2/ and Ti/sub (1-x)/V/sub x/O/sub 2/ layers whose composition depends on deposition parameters of the H.F. cathodic sputtering process of mixtures of oxide powders. In the first place, the analysis conditions of these layers were determined with the best possible accuracy. As for the experimental results, we show for the best deposition conditions (residual vacuum, pre-sputtering) that the ratio O/(M+Ti) can be adjusted to 2+-0.1 over all the target concentration ranges. The evolution of the ratio Nb/(Nb+Ti) and V/(V+Ti) is not identical to that of targets with deviations whose significance we attempt to interprete. In the second section dealing with time of flight detection of recoil nuclei, we justify our choice of experimental parameters by a detailed study of their influence on the analytical performances. In spite of serious limitations posed by angular dispersions the depth resolution typically varies from 2 to 5 nm for oxygen and carbon depending on whether one deals with a matrix of medium Z(Si) or high Z (Ta). An energy discrimination serves at optimizing the analysable depths and avoiding interferences (C,N and O analysable over 70 nm). This discrimination allows us to lower the detection limit (down to 10/sup 13/ at/cm/sup 2/) by reduction of background noise. The current limitations and possible improvements are presented from surface analysis examples.

15420 **(ND-R—1243(S)) Computed X-ray powder diffraction data for the quantitative analysis of lithium silicates.** Turek, M. (UKAEA Risley Nuclear Power Development Establishment). Aug 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750925/JAW.

Quantitative phase analysis was performed by X-ray diffraction on various preparations of Lithium Silicate. This material is being considered as the tritium breeding blanket of a thermonuclear reactor.

15421 **(NRPB-R—187) Analytical method for evaluating the uncertainty in personal air sampler determinations of plutonium intakes.** Birchall, A.; Muirhead, C.R.; James, A.C. (National Radiological Protection Board, Chilton (UK)). Oct 1985. 42p. H.M. Stationery Office, London, price Pound 5.00.

The parameters defining aerosol particle size and activity distributions are reviewed. When considering statistical variation in sampled activity, it is convenient to express the activity in terms of the number of median units of particle activity. The aerosol size distribution is characterised by the activity median aerodynamic diameter and geometric standard deviation. Numerical values are given for the median and arithmetic mean of these activity distributions, for the range of plutonium aerosols encountered in air at the workplace. The methods used by Meggitt (1979) to evaluate (I) the probability density distribution of activity p(m/w) dm, sampled from a fixed concentration w, and (II) the posterior probability density of concentration p(w/m) dw following a single measurement m, are also reviewed. These methods involve approximating the k-sum distribution, formed by summing the activity of k random particles from a log-normal population, by a shifted log-normal function. Meggitt's approximation of the k-sum distribution was found to be inadequate. An improved approximation is given, based on a transformed normal distribution.

15422 **(ORNL/TM—10614) National Center for Small-Angle Scattering Research: Reports on measurements carried out by users of the facilities of the NCSASR, December 1, 1985-September 30, 1987.** Spooner, S.; Maddox, L.B. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 254p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88003754/JAW.

Reports are presented on small angle scattering of alloys, emulsion, micellar systems, polymers, and biological materials. (CS)

15423 **(SAND—87-3088C) Anodic behavior of Ni-P and Ni-Cr-P metallic glasses.** Diegle, R.B.; Sorensen, N.R.; Clayton, C.R.; Helfand, M.A. (Sandia National Labs., Albuquerque, NM (USA); State Univ. of New York, Stony Brook (USA)). 1987. Contract AC04-76DP00789. 24p. (CONF-871027—16). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005334/JAW.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

The passivation behavior of glassy Ni-XCr-20P (X = 0,3,6, and 10 at. %) alloys is treated from an electrochemical standpoint, with supporting data for passive film chemistries obtained by x-ray photoelectron spectroscopy. Evidence is presented for passivation of Ni-20P by adsorption of hypophosphite anion, rather than a nickel oxide or oxyhydroxide film characteristic of pure Ni. This chemical passivity exists over a narrow potential range of about 500 mV. In contrast, the Cr-containing alloys develop more conventional three-dimensional films, which are enriched in phosphorus anions in the inner region and in Cr^{+3} species in the outer region. Alloying with Cr extends the passive potential range, reduces the passive current density, and confers excellent pitting resistance to the alloys. 16 figs.

15424 **(VW-FMT—8108-N/4) Measurement of polycyclic aromatic hydrocarbons in Diesel exhaust gas by a part flow process.** Hartung, A.; Kraft, J.; Schulze, J.; Hartwig, H.; Lies, K.H.; Seiffert, U.; Klingenberg, H. (Volkswagenwerk A.G., Wolfsburg (Germany, F.R.). Abt. Forschung und Entwicklung). 14 Aug 1981. 29p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751685/JAW.

A new process for the quantitative analysis of polycyclic aromatic hydrocarbons is described in this report, where the samples are collected by extracting a part flow from the diluted exhaust gas. The important advantage of this method is that apart from the exhaust gas dilution tunnel, which is required anyway for determining the particles by the American Environmental Authority (EPA) in the Federal Register, no additional apparatus is required for sampling. In contrast to the Grimmer full flow process, one only obtaines one fraction in this part flow process with sampling from the diluted exhaust gas, i.e. the Diesel particles separated on a filter, to which the polycyclic aromatic hydrocarbons are adsorptively bound. As smaller sample quantities are obtained in a part flow process, suitable processes had to be provided for treatment of the samples and for analysis (sublimation, glass capillary gas or thin film chromatography). Compared with the full flow method, the determination of the polycyclic aromatic hydrocarbons by the part flow process, together with sublimation and glass capillary chromatography, has the following advantages: Reducing the time taken by at least 50%; saving of chemical solvents; achieving very clean intermediate products, suitability for small samples. The results from the part flow and full flow methods show close agreement.

15425 **(ZE—CO854027) Reverse osmosis separation of model compounds in heptane and toluene solutions. Final report.** (Zenon Environmental, Inc., Burlington, Ontario (Canada)). 18 Jun 1986. 238p. (MICROLOG—86-05135). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Recent developments in membrane technology have indicated a considerable potential for reverse osmosis separation of binary organic solutions. Despite the need for more energy-efficient and cost-effective separation technologies in industry, separation of organic solutes from aliphatic solvents have not been widely studied. This report presents the results of the separation of model solutes from aromatic (toluene) and aliphatic (heptane and cyclohexane) solvents. Preliminary tests showed that membranes fabricated of cellulose acetate butyrate, cellulose triacetate (CTA), and polyamide nitrile were compatible with the above solvents. The membranes were cast in two porosities. The solvent permeation rates through the membranes were comparable to or better than water flux rates through commercially avbailable membranes. The separation of methanol is of particular interest to the production of new petroleum base antiknock compounds for automotive fuel. Data presented here show that CTA membrane preferentially permeates methanol from heptane solution.

15426 **Instantaneous three-dimensional concentration measurements in turbulent jets and flames.** Yip, B.; Schmitt, R.L.; Long, M.B. (Department of Mechanical Engineering and Center for Laser Diagnostics, Yale University, New Haven, Connecticut 06520). *Optics Letters;* 13: No. 2, 96-98(Feb 1988).

An experiment is described in which the instantaneous three-dimensional gas-concentration distributions in turbulent jets and flames were recorded. A resonant scanning mirror was used to sweep a laser sheet through the volume of a flow field. During the 1.4-@gmsec duration of the laser pulse, an electronic framing camera imaged the scattered light from the gas in as many as 12 parallel planes within the flow. A two-dimensional charge-coupled-device array was used to digitize the images from the framing camera in real time. The measurement period was brief enough to freeze the motion of the gas.

15427 **Polymer immobilized enzyme optrodes for the detection of penicillin.** Kulp, T.J.; Camins, I.; Angel, S.M.; Munkholm, C.; Walt, D.R. (Lawrence Livermore National Lab., CA). *Analytical Chemistry;* 59: No. 24, 2849-2853(15 Dec 1987). Contract W-7405-ENG-48.

The preparation and performance of two enzyme-based fiber-optic sensors (optrodes) capable of detecting penicillin are described. Each sensor consists of a polymer membrane that is covalently attached to the tip of a glass optical fiber. The membrane contains the enzyme penicillinase and a pH-sensitive fluorescent dye. A signal is produced when the enzyme catalyzes the cleavage of the β-lactam ring of penicillin to produce penicilloic acid and, consequently, a pH change in the microenvironment of the membrane. The sensors differ in the way the polymer membrane is constructed and in the type of pH indicator dye used. Both optrodes exhibit response times (40-60 s) significantly lower than those of the corresponding enzyme electrodes (2 min). Each gives a linear response over the concentration range of 0.00025 to 0.01 M penicillin G, when measured in a 0.005 M phosphate buffer. The data indicate that these immobilization strategies produce similar results and may be considered complementary alternatives in future enzyme optrode applications.

15428 **Mechanisms of graphite furnace atomization of aluminum by molecular beam sampling mass spectrometry.** Styris, D.L.; Redfield, D.A. (Pacific Northwest Lab., Richland, WA). *Analytical Chemistry;* 59: No. 24, 2891-2897(15 Dec 1987). Contract AC06-76RL01830.

Mechanisms that control atomization of aluminum and its modification by magnesium in the graphite furnace are investigated by the molecular beam sampling technique. Oxides and numerous carbides of aluminum are observed to appear with the free aluminum. These molecular species are precursors to free aluminum only when magnesium is present. It appears that release of adsorbed aluminum is dependent on depletion of the gas-phase magnesium oxide. Magnesium also inhibits loss of aluminum as the dihydroxide during the thermal pretreatment steps. Reactions contributing to these observations are presented and the influence of the surface is discussed.

15429 **Hadamard transform visible Raman spectrometry.** Tilotta, D.C.; Freeman, R.D.; Fateley, W.G. (The Department of Chemistry, Willard Hall, Kansas State University, Manhattan, Kansas 66506). *Applied Spectroscopy;* 41: No. 8, 1280-1287(Nov 1987).

The successful application of LC-SLM Hadamard transform spectrometry as a simultaneous multiwavelength detection system to Raman spectroscopy is presented. Multiplexed Raman data are obtained with the use of an Ar^+ laser lasing at 514.5 nm and a room-temperature silicon photodiode. A conventional 90° scattering geometry is employed for measurements. It is demonstrated that the LC-SLM Hadamard transform Raman spectrometer possesses the capability of performing spectral subtraction and the ability to obtain depolarization ratios of Raman bands, and can function as a selectively tunable optical filter for both Rayleigh line rejection and optical band notching. It is also demonstrated that, for the Hadamard transform Raman experiment, the silicon photodiode used as the detector produces spectra with slightly better signal-to-noise ratios than those obtained with the photomultiplier tube (PMT) used as the detector, although the PMT shows an increase in sensitivity.

15430 **FT-IR micro-spectroscopic studies of several charge-transfer organic electrical conductors.** Ferraro, J.R.; Wang, H.H.; Ryan, J.; Williams, J.M. (Loyola University, Department of Chemistry, Chicago, Illinois 60626 (J.R.F.); Argonne National Laboratory, Chemistry and Materials Science Divisions, Argonne, Illinois 60439 (H.H.W., J.M.W);). *Applied Spectroscopy;* **41**: No. 8, 1377-1382(Nov 1987). Contract W-31-109-ENG-38.

A series of infrared reflectance measurements using FT-IR Micro methods were conducted on bis(ethylenedithio)tetrathiafulvalene (BEDT-TTF or "ET") and bis(propylenedithio)tetrathiafulvalene (BPDT or "PT") salts of the type $(ET)_2X$, where $X = I_3^-$, $AuCl_2^-$, $AuBr_2^-$, AuI_2^-, I_2Br^-, IBr_2^-, ICl_2^-, ReO_4^-, ClO_4^-, and $CH_3\text{-}X\text{-}SO_3^-$; and $(PT)_2X$, where $X = I_3^-$, IBr_2^-, I_2Br^-, and ICl_2^-. The technique is useful for characterizing, at room temperature, differences between β-, β'-, and α'-type structures vs. α-structures. The β-,β', and α'-type structure show a vibrational features at $\sim$1280 cm^{-1} which has been assigned as the -C-C-H bending vibration and is absent in the spectrum of the α-type salts. This vibration shifts toward higher frequency in going from the PT to the ET salts, and the results indicate stronger hydrogen bonding and harder lattices in the ET salts as opposed to the PT salts. This frequency shift also appears to be a function of the electronegativity of the halogen in the anion moiety of the charge-transfer salt.

15431 **Direct supersonic expansions of supercritical fluids for analysis of polycyclic aromatic hydrocarbons.** Goates, S.R.; Barker, A.J.; Zakharia, H.S.; Khoobehi, B.; Sheen, C.W. (Department of Chemistry, Brigham Young University, Provo, Utah 84602). *Applied Spectroscopy;* **41**: No. 8, 1392-1397(Nov 1987).

Significant line-narrowing has been observed in the laser-induced fluorescence spectra of naphthalene and perylene in direct supersonic expansions of simple supercritical carriers such as CO_2, N_2O, and even SF_6, under conditions which minimize aerosol and cluster formation. Clusters form readily in expansions of CO_2 and N_2O unless nozzle temperatures exceed about 200 °C. Results with more complex carriers, such as n-pentane, are much poorer. Selective detection of perylene at a limit of 2 ng (S/N = 3) in a mixture of ten polycyclic aromatic hydrocarbons and in a coal tar extract has been achieved with a capillary introduction system. Challenges with coupling supersonic jet detection to a capillary supercritical fluic chromatography lie with the nozzle.

15432 **Computer-controlled densitometer for the analysis of photographically recorded optical emission spectra.** Hareland, W.A.; Grant, S.E.; Ward, S.P.; Anderson, D.R. (Sandia National Laboratories, Albuquerque, New Mexcio 87185 (W.A.H.); and Allied Bendix Aerospace, Kansas City Division, Kansas City, Missouri 64141 (S.E.G., S.P.W., D.R.A.)). *Applied Spectroscopy;* **41**: No. 8, 1422-1427(Nov 1987). Contract AC04-76DP00789.

A computer-controlled densitometer for data acquisition and high speed analysis of photographically recorded optical emission spectra has been developed. The instrument scans and digitizes spectra and stores the data sequentially in computer memory. A high-resolution linear measurement transducer mounted on a Jarrell-Ash densitometer monitors the plate position as the spectrum is scanned. The transducer measurement is accurate to within 0.001% over a range of about 340-mm on a glass photoplate. Computer algorithms for locating and identifying peaks and for calculating the wavelengths of spectral lines from their positions in the spectrum are described. With the use of a calibration curve based on the measured positions of three known spectral lines, the wavelength of any spectral line can be determined to within 0.005 nm, and the transmittance of a peak in the recorded spectrum can be measured to within 1%. The wavelengths and transmittances of all detectable spectral lines in the digitized emission spectrum are determined in less than two minutes.

15433 **Laser spectroscopy of jet-cooled chlorinated aromatic hydrocarbons.** Rohlfing, E.A.; Chandler, D.W. (Combustion Research Facility, Sandia National Laboratories, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 618-620(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

Laser-induced fluorescence and resonance-enhanced multiphoton ionization spectroscopies are applied to jet-cooled mono- and dichloronaphthalenes. Both techniques provide isomeric selectivity in S_1-S_0 excitation, however REMPI is more sensitive to the weakly fluorescing dichloronaphthalenes and shows isomerically dependent ion fragmentation patterns.

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REFER ALSO TO CITATION(S) 13959, 14370, 15155, 15263, 15373, 15507, 16047, 16443, 16446, 16482, 17275

15434 **(AEEW-R—1995) Reaction of selected metal powders with Arklone.** Benson, C.G.; Hawes, P.M. (UKAEA Atomic Energy Establishment, Winfrith). Oct 1985. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750887/JAW.

Experimental work has been carried out to investigate possible reactions between Arklone 1,1,2-trichloro-1,2,2-trifluroethane and magnesium, beryllium and aluminium powders. Differential Thermal Analysis was used to study small scale samples in the temperature range from -35 to 200°C. Larger scale studies were also carried out using pure Arklone and Arklone with water or acids (HCL or HF) as contaminants. Results are reported for metal powders of various particle sizes. The systems studied were all found to be unreactive in conditions which are expected to be encountered in a Decontamination and Disposal Facility.

15435 **(AEEW-R—2102) Interaction of caesium iodide with boric acid: vapour phase and vapour-condensed phase reactions.** Bowsher, B.R.; Dickinson, S. (UKAEA Atomic Energy Establishment, Winfrith). May 1986. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750864/JAW.

The interaction was studied using thermal gradient and vacuum techniques. The generation of hydrogen iodide was inhibited but not completely prevented by the presence of cesium hydroxide. The volatility of boric acid was greatly increased in a steam atmosphere and this prevented co-condensation with cesium iodide and therefore reactions involving condensed boric acid were less significant. The implications of such reactions to generate volatile iodine species from cesium iodide are discussed with reference to specific hypothetical severe accident sequences in PWRs.

15436 **(AERE-R—11658) Iodine hydrolysis reactions. Part 2. Preliminary species identification and rate measurements.** Deane, A.M. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.). Jun 1986. 27p. H.M. Stationery Office, London, price Pound 4.00.

Part 1 - AERE-R-11657(1985).

The variation with time of the spectra of dilute iodine solutions has been measured. Measurements were made on a pure iodine solution and on solutions to which silver ions were added to perturb the equilibria. The component features of the spectra have been evaluated and a model developed which allows preliminary

identification of the spectra of HI_3O^-, HIO_3 or IO_3^- and possibly $H_3IOO_3^+$. Initial estimates of rate constants or equilibrium constants have been made for several reactions.

15437 (CEGB-TPRD/B—0688/R85) Reaction kinetics of iodine compounds in aqueous solution. Sellers, R.M. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1985. 51p. (PWR-CWG-P—86-394). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750930/JAW.

A review is presented of the reaction kinetics of inorganic iodine species in aqueous solution, and describes the establishment of a kinetics data base for use in computer modelling of iodine release in PWR design basis faults. A data base of 167 reactions has been established to describe the behaviour of inorganic iodine species in solution. Organic iodides have been omitted because of the lack of understanding about how they are formed. A number of inadequacies in the data base requiring further research are noted.

15438 (CONF-840748—2) Geometric and electronic effects of SMSI [Strong Metal-Support Interactions] in Group VIII-TiO_2 systems. Haller, G.L.; Henrich, V.E.; McMillan, M.; Resasco, D.E.; Sadeghi, H.R.; Sakellson, S. (Yale Univ., New Haven, CT (USA)). 1984. Contract AC02-81ER10830. 11p. NTIS, PC A03. Order Number DE88005023/JAW.

From 8. international congress on catalysis; Berlin, F.R. Germany (2 Jul 1984).

To date most experiments designed to probe Strong Metal-Support Interactions (SMSI) have focused on electron transfer between the metal and the support. For certain structure sensitive reactions, e.g., hydrogenolysis, SMSI can be understood to be of geometric origin and caused by migration of a species from the support onto the metal particle. We present three kinds of evidence for this model for the Rh/TiO_2 system: Auger sputter profiling of model catalysts, extended x-ray absorption fine structure (EXAFS) analysis and infrared spectra of chemisorbed CO. The hydrogenation of CO and decomposition of NH_3 are, like hydrogenolysis, structure sensitive. However, SMSI has very little effect on these reactions. In the case of CO hydrogenation, SMSI is reversed by the reaction products CO_2 and H_2O. Apparently the most abundant surface species in NH_3 decomposition, chemisorbed N atoms, competes with migrated support species. 34 refs., 5 figs., 2 tabs.

15439 (CONF-8706258—1) Mass spectrometry studies of fission product behavior: 2, Gas phase species. Blackburn, P.E.; Johnson, C.E. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003070/JAW.

From US/Japan seminar on high-temperature chemistry of current light water reactors of advanced all-metal reactors; Tokyo, Japan (6 Jun 1987).

Revaporization of fission products from reactor system surfaces has become a complicating factor in source term definition. Critical to this phenomena is understanding the nature and behavior of the vapor phase species. This study characterizes the stability of the CsI . CsOH vapor phase complex. Vapor pressures were measured with a mass spectrometer. Thermodynamic data were obtained for CsOH(g), $Cs_2(OH)_2$(g), CsI(g), Cs_2I_2(g) and CsI . CsOH(g). Activity coefficients were derived for the CsI-CsOH system. The relative ionization cross section of CsOH is about ten times the cross section of CsI(g). CsI . CsOH fragments to Cs_2OH^+ and an iodine atom. 17 refs., 4 figs., 6 tabs.

15440 (DOE/ER/06042—8) Properties of lanthanide oxides as supports for transition metal catalysts: Progress report, May 1, 1987-April 30, 1988. Rosynek, M.P. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). 1988. Contract AS05-78ER06042. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004520/JAW.

Objective of this research program has been to provide an understanding of the manner in which variations in metal precursors and oxidic support materials, particularly lanthanide oxides, influence the reduction behaviors and catalytic/surface properties of dispersed non-noble Group VIII transition metals. Support materials selected for study provide appropriate variations in several important physical/chemical properties, including acid-base character and cationic multi-valency. Goals of the project have been to attain an increased understanding of the general phenomenon of support effects, and to enable correlations to be made between physical/chemical properties of support materials and the catalytic behaviors of transition metals that are dispersed on their surfaces. Our research effort has comprised the following areas of investigation: hydrocarbon conversion and surface carbon formation on dispersed nickel catalysts, reduction behaviors/catalytic properties of supported cobalt, and NH_3 and CO_2 adsorption onto an evacuated La_2O_3 surface. 33 refs., 15 figs., 2 tabs.

15441 (DOE/ER/13191—8) Kinetic studies following state-selective laser excitation: Annual performance report for the period March 15, 1987-March 14, 1988. Keto, J.W. (Texas Univ., Austin (USA). Dept. of Physics). Nov 1987. Contract FG05-84ER13191. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004094/JAW.

The objective of this contract is the study of state-to-state, electronic energy transfer reactions following two-photon laser excitation. We have specifically been studying reactions of Xe $5p^6 6p$ because of their relevance to the XeCl excimer laser. We are studying deactivation reactions in collisions with heavy atoms such as Ar, Kr, and Xe and reactive collisions with chlorides. The reactants are excited by multiphoton laser absorption. Product channels are observed by their fluorescence, or in experiments in the coming months by laser induced fluorescence using a second color laser. Reaction rates are measured by observing the time dependent decay of signals from reactant and product channels. In addition we measure interaction potentials of the reactants by laser spectroscopy where the laser induced fluorescence or ionization is measured as a function of laser wavelength (excitation spectra) or by measuring fluorescence spectra at fixed laser frequencies with monochromators. The spectra are obtained in the form of either lineshapes or individual lines from rovibrational transitions of bound states. 4 figs.

15442 (DOE/ER/13213—10) Laser studies of the dynamics of free radical reactions: Final report. Halpern, J.B. (Howard Univ., Washington, DC (USA). Laser Chemistry Lab.). 1986. Contract FG05-84ER13213. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004431/JAW.

Principal achievements of this research program have been: development of a series of photochemical sources for CN radicals. By choosing among sources and excitation wavelengths one can select the absolute and relative amounts of rotational, vibrational and translational energy in the nascent CN fragment; rates of reaction were measured for ground state CN radicals with O_2, CH_4, H_2 and a variety of hydrocarbons were measured; rates of reaction were measured for the CN molecule in the first excited vibrational state with many molecule. In particular, it was found that there is an enormous increase of the reaction rate for the reaction with NO. Results for reaction rates are discussed using several parameterized models. Reactions with hydrocarbons seem to correlate with an attractive potential. 14 refs., 2 figs., 1 tab.

15443 (DOE/ER/13501—01) Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding: Progress report for year ending February 28, 1988. Lichtenberger, D.L. (Arizona Univ., Tucson (USA). Dept. of Chemistry). 15 Dec 1987. Contract FG02-86ER13501. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004465/JAW.

Results are reported in the following areas: fundamental principles of ionization energy/bond energy relationships; relative strengths of early transition metal M-H and M-C bonds in substituted niobocenes and tantalocenes. Thermodynamic trends and electronic factors of olefin insertion into a metal-hydride bond; additivity of ligand electronic effects. Complete phosphine substitution of Group VI metal hexacarbonyls; organometallic methylene-bridged metal dimers. Delocalization of metal electron density in metallacycle formation; metal-heteroatom and metal-alkylidyne multiple bonds. The electronic factors favoring intermediates in acetylene metathesis and polymerization; improvements in an electron energy analyzer. 4 figs.

15444 **(DOE/ER/13564—4) Chemistry of bimetallic cyclopentadienyl complexes: Progress report for period June 1, 1986 to November 30, 1987.** Schrock, R.R. (Massachusetts Inst. of Tech., Cambridge (USA)). 1987. Contract FG02-86ER13564. 2p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003325/JAW.

A brief description of the research and results are presented in the following areas: chemistry of homo- and heterobimetallic complexes containing peralkylated cyclopentadienyl rings; study of WCp methyl complexes; permethyl linked cyclopentadienyl complexes containing two tungstens or one tungsten and a group 8 metal. (CS)

15445 **(DOE/ER/13678—7) Precipitation of surfactants and surfactant mixtures in aqueous solutions.** Stellner, K.L. (Oklahoma Univ., Norman (USA)). 1987. Contract FG05-87ER13678. 193p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88003333/JAW.

The precipitation of an anionic surfactant by several different counterions is examined. The counterions include: Na^+, Ca^{+2}; and a monovalent counterion which is a cationic surfactant. At concentrations below the CMC(critical micelle concentration), surfactant precipitation is similar to precipitation of any simple salt and can be described by a solubility product relationship. Above the CMC, when micelles are present, the solubility product must be written between the anionic surfactant monomer concentration and the unbound (unassociated) counterion concentration. A model has been developed for each system that successfully predicts the counterion concentration required to cause precipitation. The primary goal of this work is to understand the changes in anionic surfactant precipitation brought about by adding nonionic surfactant and/or NaCl. In anionic-nonionic surfactant mixtures, monomer-micelle equilibrium is described using a pseudo-phase approach combined with a regular solution theory assumption for the micelles. 100 refs., 40 figs., 7 tabs.

15446 **(DOE/ER/40237—T4) Chemistry of gaseous, lower valent actinide halides.** Hildenbrand, D.L.; Lau, K.H. (SRI International, Menlo Park, CA (USA)). 29 May 1987. Contract AC03-85ER40237. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003509/JAW.

Planning is reported for measurements of thermodynamic/thermochemical properties of UBr_4, $ThBr_4$, UOCl, ThOCl, UOBr, ThOBr, Np halides, UF, and U_3O_8. (DLC)

15447 **(DOE/ER/45120—6) Heterogeneous catalysis: A molecular perspective.** Augustine, R.L.; O'Hagan, P.J.; Lahanas, K.M. (Seton Hall Univ., South Orange, NJ (USA). Dept. of Chemistry). 1987. Contract FG02-84ER45120. 10p. (CONF-880604—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004464/JAW.

From Joint meeting of the 195th national meeting of the American Chemical Society and the 3rd Chemical Congress of North America; Toronto, Canada (5 Jun 1988).

A basic understanding of the mechanisms of a heterogeneously catalyzed process would be of great use to the synthetic chemist. Presently, the most important synthetic use of dispersed metal catalysts is in the hydrogenation of functional groups. However, these catalysts could be used in many other reactions. But it is necessary to develop a more detailed picture of the types of surface atoms which could be present on the metals and knowledge of the reaction characteristics of each one. This paper addresses this issue. 12 refs., 6 figs., 1 tab. (CS)

15448 **(DOE/PC/70808—T2) Intercrystalline anion exchange, sorption, and base catalysis: Quarterly progress report, April-June 1987.** Marcelin, G. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1987. Contract FG22-84PC70808. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004672/JAW.

Current effects are aimed at determining the acid-base characteristics of the layers in these materials. The decomposition of 2-propanol was studied over calcined hydrotalcite-like materials of Mg-Al, Zn-Cr, Ca-Al, and Ni-Al. All the decomposed hydrotalcite-like materials showed significant selectivity for ketone formation, i.e., the base catalyzed product. In general the selectivity of the base catalyzed pathway was found to depend on the nature of the cations in the layers, as: Zn-Cr, Ca-Al > Ni-Al > Mg-Al. 2 refs., 2 figs.

15449 **(INIS-BR—910, pp 4) /sup 129/Xe NMR study of adsorbed Xenon: a new method for the study of zeolites and metal-zeolites.** Fraissard, J. (Paris-6 Univ., 75, France. Lab. de Chimie des Surfaces). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

15450 **(JAERI-M—87-140) Determination of D/sub 2/O contents of water at low levels by mass spectrometry: water-hydrogen isotope equilibration method.** Watanabe, Kazuo; Ouchi, Misao. (Japan Atomic Energy Research Inst., Tokyo). Sep 1987. 19p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751977/JAW.

A simple analytical method for the determination of D/sub 2/O concentration of water at low levels (below 10 mol%) is established. Hydrogen gas is brought into isotope equilibrium with samples of water in the presence of hydrophobic platinum catalyst. Isotope exchange equilibrium is attained within 30 min. Isotopic analysis of the equilibrated hydrogen gas is performed with mass spectrometry. Relative standard deviation is 1 ~ 5 % for D/sub 2/O concentration in the range 0.07 ~ 10 mol%. Absolute determination of D/sub 2/O is possible by making calibration with standard samples of known D/sub 2/O concentration.

15451 **(LBL—24230) The synthesis and chemistry of organoiridium allyl and oxo complexes.** McGhee, W.D. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004558/JAW.

$Cp^*Ir(eta^3\text{-}C_3H_5)H$ (2, Cp^* = $eta^5\text{-}C_5Me_5$) was cleanly synthesized. Thermolysis of 2 in benzene in the presence of phosphines produced $Cp^*(PR_3)Ir(n\text{-}C_3H_7)(C_6H_5)$ (R = Me, Ph), and in hydrocarbon solvents gave substituted π-allyliridium hydride species. Two mono- and dinuclear cyclometallated complexes were isolated. Thermolysis of $Cp^*(eta^3\text{-}C_3H_5)IrH$ in concentrated benzene solutions produced $Cp^*(C_6H_5)Ir(\mu\text{-}H)(eta^1,eta^3\text{-}C_3H_4)IrCp^*$. The structure was determined crystallographically. Addition of dative ligands to 1 produced benzene and $Cp^*(L)Ir(eta^1,eta^3\text{-}C_3H_4)IrCp^*$ (2-6, L = PMe_3, CO, $CH_2{=}CH_2$, $P(OMe_3)_3$ and t-BuNC). Thermolysis of the PMe_3 complex 2 gave rise to the intramolecular C-H bond activation product. Addition of $LiEt_3BH$ to $Cp^*(PMe_3)(eta^1\text{-}C_3H_5)IrCl$ produces the iridacyclobutane complex $Cp^*(PMe_3)IrCH_2CH_2CH_2$. Dehydration of $[Cp^*Ir(\mu\text{-}OH)_2IrCp^*]^+OAc^-$ with amine bases generated the bis-μ-oxo complex $[Cp^*IrO]_2$. Addition of PPh_3 to 1 produced $O{=}PPh_3$ and $Cp^*(PPh_3)Ir(\mu\text{-}O)Cp^*Ir$. The structure was determined crystallographically. 22 refs., 23 figs., 4 tabs.

15452 **(LBL—24382) The reaction of silicon with atomic hydrogen by modulated molecular beam mass spectrometry.** Abrefah, J. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 126p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88005260/JAW.

The gas-solid reaction of single crystal silicon, Si(111), and atomic hydrogen were studied in an uhv chamber with an atomic hydrogen beam produced by thermally dissociating molecular hydrogen in a tungsten oven at 2500°K. Silicon was not etched by molecular hydrogen but interacted very strongly with atomic hydrogen to produce the volatile silicon tetrahydride, SiH_4, and molecular hydrogen by recombination of surface-absorbed H atoms. The silicon surface was characterized by in situ Auger electron spectroscopy (AES). The temperature was 300°K to 1000°K in most tests, with some data above 1000°K. The equivalent beam intensity at the target ranged between 10^{15} to 10^{17} atoms cm^{-2} sec^{-1}, and the chopping frequency was varied from 20 Hz to 900 Hz. The apparent reaction probabilities and the phase lags of the SiH_4 and H_2 products were measured as functions of these experimental variables. Approximately 50% of the incident H atoms recombined on

the surface and were re-emitted as molecular hydrogen. The SiH_4 reaction probability was highest at room temperature (≈3%), and decreased with increasing temperature up to about 1000°K. At 1100°K, where Si(111) changes surface structure from Si(111)-7 x 7 to Si(111)-1 x 1, the production of SiH_4 was a minimum, and increased with further increase in temperature. No reaction was observed with an oxidized silicon surface, and oxygen surface concentrations above 1% had a significant effect on reducing the strength of the reaction. The mechanism involves saturation of the surface dangling bonds by atomic hydrogen, formation of SiH and SiH_3 surface complexes, and reaction with a weakly-bound overlayer of hydrogen. The weakly bound hydrogen is mobile. It diffuses into the bulk and reacts with the SiH_3 complex to form SiH_4. Stepwise rate constants were determined.

15453 **(LBL—24514) Utilization of the JANAF [Joint Army Navy Air Force] database for chemical thermodynamic calculations.** Bafi, A.S. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004571/JAW.

A computer code is presented here that calculates the standard-state free energy change and the equilibrium constant for a specified reaction aA + bB = cC + dD. In computing these values, this code utilizes the JANAF thermochemical data file. If desired, certain additional thermodynamic values for the individual reactants and products can also be included in the output of this code. 4 refs., 1 fig.

15454 **(MLM—3469) Supported palladium materials for isotope separation.** Rutherford, W.M.; Ellis, R.E.; Abell, G.C. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 21 Jan 1988. Contract AC04-76DP00053. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005245/JAW.

Several palladium packing materials were investigated for their suitability for use in the separation of hydrogen isotopes by displacement chromatography. The materials included palladium on Chromosorb and several formulations of palladium on commercially available alpha-alumina-based catalyst supports. All materials showed some degradation upon being subjected to repeated hydriding-dehydriding cycles; however, the degradation did not lead to unacceptably low permeability to gas flow. Dynamic performance of the packings was evaluated by displacement of deuterium with protium at several temperatures and flow rates. Isotopic exchange was generally rapid. However, high surface area packings (greater than 4 m^2/g) yielded transition zones that were initially sharp, but had long "tails" at deuterium concentrations below 5%. Best results were obtained with a packing containing 48.2% palladium on Norton catalyst support No. SA5°21 (surface area = 0.33 m^2/g). Improved performance was observed as the displacement temperature was increased to 80°C from 22°C. The slight decrease in equilibrium separation was more than offset by improved kinetics at the higher temperature. 19 figs., 6 tabs.

15455 **(N—88-12538) Compatability of dispersion-strengthened platinum with resistojet propellants.** Whalen, M.V.; Nathal, M.V. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1987. 29p. (NASA-TP—2765; E—3738; NAS—1.60:2765). NTIS, PC A03/MF A01.

Resistojets for the Space Station require long life and multi-propellant capability. The choice of available materials to meet these requirements is limited. Dispersion-strengthened platinum was selected. Past results indicated that it should be sufficiently inert in candidate propellant environments and should be capable of operating at moderate temperatures for extended periods. A series of propellant compatibility tests was done with platinum strengthened with either yttria or zirconia. Data presented included the results of 1000-hr tests in CO_2, H_2, ammonia (NH_3), N_2, steam, hydrazine (N_2H_4), and methane (CH_4); and 2000-hr tests in H_2 and NH3. The platinum samples were tested at 1400 C in CO_2, H_2, NH_3, N_2, steam, and N_2H_4; at 500 C in CH_4; and at 800 C in N_2H_4. The mass-loss results indicated material life, exptrapolated from experimental mass-loss data, in excess of 100 000 hr in all environments except steam and N_2H_4, where it was greater than or =45000 hr. Generally, on the basis of mass loss, there were no compatibility concerns in any of the environments considered. Optical and scanning electron microscopy were used to determine the effect of propellants on the material surface and to evaluate material stability.

15456 **Dependence of the N_2 vibrational potential on density.** Engelke, R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* 88: No. 4, 2159-2161(15 Feb 1988).

Recently, part of the vibrational spectrum of the ground electronic (X ^{1}summation$^+$/sub g/) state of condensed phase N_2, shocked to high density, has been measured by Schmidt, Moore, and Shaw. Densities (rho) of nearly three times the ambient liquid value were obtained in the shock wave experiments. Due to the high temperatures achieved behind the shock waves, up to six vibrational levels of N_2 were observed. These vibrational spectra show clear frequency shifts from their ambient condition values. Here, these experimental spectra are used to infer changes in the vibrational potential of N_2 due to the high density environment. The vibrational portion of the Rydberg—Klein—Rees (RKR) method is used to do this. We find that, in the range of densities studied, the energies [E(n;rho)] of the first five vibrational transitions of N_2 can be accurately represented by E(n;rho) = ω/sub e/(rho)(n+ 1/2)-ω/sub e/x/sub e/(n+ 1/2)^2, where ω/sub e/(rho) = ω°/sub e/+A[1-(rho$_0$/rho)^1/sup //^{3}] and ω/sub e/x/sub e/ is a constant which is independent of the thermodynamic state of the environment; here, ω°/sub e/ and A are fitting constants and rho$_0$ and rho are the ambient (liquid) and shocked densities of N_2. Given E(n;rho), one can obtain the classical turning point difference, r_{12}, of the N_2 potential as a function of n and rho by using the RKR procedure. It is found that at the highest shock density observed (2.13 g/cm^3), the relative change in r_{12} from the ambient condition values is about -1% for the first six vibrational levels.

15457 **Reaction of O(^{3}P) atoms with ethane: An HTP kinetics study from 300 to 1270 K.** Mahmud, K.; Marshall, P.; Fontijn, A. (Department of Chemical Engineering, Rensselaer Polytechnic Institute, Troy, New York 12180-3590). *Journal of Chemical Physics;* 88: No. 4, 2393-2397(15 Feb 1988).

Rate coefficients for the O+C_2H_6 reaction have been measured using the high-temperature photochemistry (HTP) technique. Strong non-Arrhenius behavior is observed. The data are well fitted by the empirical expression k(T) = 1.9 x 10^{-31} T/sup 6.5/ exp(-138 K/T) cm^6 molecule^{-1} s^{-1}. Confidence limits are discussed in the text. The results are consistent with calculations based on transition state theory and tunneling through an Eckart barrier.

15458 **Phase space analysis of the collinear I+HI reaction.** Skodje, R.T.; Davis, M.J. (Department of Chemistry and Biochemistry, University of Colorado, Boulder, Colorado 80309). *Journal of Chemical Physics;* 88: No. 4, 2429-2456(15 Feb 1988).

The collinear I+HI reaction is studied using an approach based on the concepts of nonlinear dynamics. Three closed regions in phase space are constructed by connecting the dynamical manifolds emanating from physically important periodic orbits. It is shown that many features of the reaction dynamics can be understood with reference to these regions. The oscillating reaction probability in this system is shown to stem from the geometrical pattern of overlap of heteroclinic oscillations of an interaction region. The process of complex formation is quantitatively described in terms of passage into a well defined complex region of phase space. The phase space representation predicts that the complex formation probability oscillates with energy and suggests that the complex lifetime might oscillate as well. We have carried out simulations which confirm both of these effects. The vibrational adiabatic approximation for the reaction is assessed relative to the exact classical dynamics.

15459 **Thermodynamics far from equilibrium: Reactions with multiple stationary states.** Ross, J.; Hunt, K.L.C.; Hunt, P.M. (Department of Chemistry, Stanford University, Stanford, California 94305). *Journal of Chemical Physics;* 88: No. 4, 2719-2729(15 Feb 1988).

We present a thermodynamic analysis of global validity for effectively one-variable, irreversible chemical systems with multiple steady states. A hypothetical reaction chamber is held at constant temperature and volume and is connected by selectively permeable membranes to reservoirs of reactant(s) and product(s), each at constant selected pressures. An appropriate free energy function, which yields criteria of evolution to equilibrium for the composite system of reaction chamber and reservoirs, is a hybrid of Gibbs and Helmholtz free energies. The one variable in the reaction chamber is the pressure of a chemical intermediate which varies in time according to a given reaction mechanism. With the hybrid free energy, the kinetics for a given mechanism, and a concept of instantaneous indistinguishability of systems with different mechanisms, we establish a thermodynamic driving force, or species-specific affinity, for the intermediate. The species-specific affinity vanishes at steady states, and upon its differentiation we obtain necessary and sufficient conditions for the stability of steady states and for critical points. The integral of the species-specific affinity globally provides valid Liapunov functions for the evolution of the intermediate. These results are independent of the number of steady states of the system, and they hold both near to and far from equilibrium. For a large class of mechanisms with a single intermediate, the integral of the species-specific affinity appears in the irreversible part

15460 **Chemical probes of metal cluster structure: Reactions of iron clusters with hydrogen, ammonia, and water.** Parks, E.K.; Weiller, B.H.; Bechthold, P.S.; Hoffman, W.F.; Nieman, G.C.; Pobo, L.G.; Riley, S.J. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **88**: No. 3, 1622-1632(1 Feb 1988). Contract W-31-109-ENG-38.

Evidence is presented for structural changes in iron clusters in the Fe_{13} to Fe_{25} size range. Abrupt changes with cluster size are found for several chemical properties, including reactivity with hydrogen and binding energies of ammonia and water. These changes often come at the same cluster sizes, pointing to a common origin: fundamental changes in the structure of the bare iron clusters. In addition, changes in structure as a consequence of adsorbate binding are suggested. The experimental observations leading to these conclusions are detailed, and possible structures for clusters in this size range are proposed.

15461 **One-dimensional reactive systems: The effect of diffusion on rapid bimolecular processes.** Peacock-Lopez, E.; Keizer, J. (Department of Chemistry, B-040 and Institute for Nonlinear Science, R-002, University of California San Diego, La Jolla, California 92093). *Journal of Chemical Physics;* **88**: No. 3, 1997-2003(1 Feb 1988).

Bimolecular reactions in one dimension are studied using the fluctuation—dissipation theory. In particular, we calculate the rate constants for three reactive systems. First, for an infinite straight line, we consider the reaction $A+A \rightarrow A+P$, and the isomerization $2A \rightarrow A_2$. In the first case, we obtain a linear dependence between rate constant and the reactant concentration. In the second, we obtain the same linear dependence only when the characteristic dimerization time tau/sub d/ is much greater than the characteristic pumping time tau/sub p/. On the other hand if tau/sub p/>>tau/sub d/, we find a rate constant which is independent of the reactant concentration. Our results are in qualitative agreement with recent computer simulations of these reactions. Second, we consider trapping, $A+S \rightarrow S$, by static sinks on a ring. For the cases of interest, we find negligible corrections, due to curvature, to the functional form of the infinite straight line rate constant.

15462 **Oxygen on Pd(100): Order, reconstruction, and desorption.** Chang, S.; Thiel, P.A. (Department of Chemistry and Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics;* **88**: No. 3, 2071-2082(1 Feb 1988). Contract W-7405-ENG-82.

We have investigated the temperature and coverage-dependent transformations of the ordered structures of oxygen on Pd(100). The four ordered structures are the chemisorbed c(2 x 2) and p(2 x 2) lattices, and the reconstructed p(5 x 5) and ((5)/sup 1/2/ x (5)/sup 1/2/)R27° lattices. We present evidence that the p(5 x 5) reconstruction forms in an activated stepfrom c(2 x 2) regions. The onset of p(5 x 5) formation is associated with an increase in oxygen sticking coefficient. In thermal desorption, there are three states which can be correlated directly with the structure of the adsorbed phase during desorption: At lowest coverage, the α state shows the traits of second-order kinetics and is due to desorption from a disordered adlayer. At higher coverage, the β state appears and is due to desorption from a layer with c(2 x 2) order. There is a lower barrier to desorption in the β state than in the α state because of the repulsive second-nearest-neighbor interactions in the c(2 x 2). At highest coverage, the sharp and narrow γ state emerges. This is accompanied by decomposition of the ((5)/sup 1/2/ x (5)/sup 1/2/)R27° reconstruction, in which cooperative stabilization of the reconstruction by oxygen atoms effectively creates strong quasiattractive oxygen—oxygen interactions. There are interesting similarities between the oxygen-stabilized reconstructions of Pd(100) and the initial stages of oxidation of Ni(100), as well as the oxygen-stabilized reconstructions of Pt(100).

15463 **Improved analysis of transient ESR signals of photoexcited triplet states: Application to chlorophyll-a in a glassy matrix.** Hiromitsu, I.; Kevan, L. (Department of Chemistry, University of Houston, Houston, Texas 77004). *Journal of Chemical Physics;* **88**: No. 2, 691-695(15 Jan 1988).

An improved analysis is presented for the kinetic traces of the electron spin resonance (ESR) signal intensity of photoexcited triplet states during and after a rectangular light pulse. It is assumed that the mixing ratio ξ/sub p/, defined by <1chemical bond1> = ξ/sub p/(qchemical bondq)+(1-ξ/sub p/)(rchemical bondr) and <-1chemical bond-1> = (1-ξ/sub p/)(qchemical bondq)+ξ/sub p/(rchemical bondr), deviates from 1/2, where chemical bond1>, chemical bond0>, chemical bond-1>, and chemical bondp), chemical bondq), chemical bondr) are the spin wave functions for the triplet sublevels with and without an external magnetic field parallel to the p principal molecular axis with p, q, r = x,y,z or a cyclic permutation thereof. An X-band ESR experiment is done for the chlorophyll-a (Chla) triplet state in a methanol—methylene chloride glassy matrix at 77 K. Previous theory fits the y and z components but not the x component. This failure can be attributed to the fact that ξ/sub p/not =1/2, and the improved analysis fits well for the x component as well as the y and z components with ξ/sub x/ = 0.555 +- 0.010.

15464 **Kinetics and thermodynamics of the reaction $H+NH_3$arrow-right-leftNH_2+H_2 by the flash photolysis—shock tube technique: Determination of the equilibrium constant, the rate constant for the back reaction, and the enthalpy of formation of the amidogen radical.** Sutherland, J.W.; Michael, J.V. (Brookhaven National Laboratory, Department of Applied Science, Upton, New York 11973). *Journal of Chemical Physics;* **88**: No. 2, 830-834(15 Jan 1988). Contract AC02-76CH00016.

Equilibrium constants K_1 for the reaction $H+NH_3$arrow-right-leftNH_2+H_2 were measured over the temperature range 900 to 1600 K using a flash photolysis—shock tube apparatus. The experimental values of K_1 ranged from 1.0 at 900 K to 2.2 at 1620 K with an estimated experimental error of about +- 10%. The value obtained from the third law analysis for the enthalpy of formation of the amidogen radical, $\Delta H°$/sub f/sub 298/ (NH_2), is 45.3 kcal/mol ($\Delta H°$/sub $f/_0$ = 46.0). The corresponding value for the bond dissociation energy, $D°(NH_2—H)$, is 107 kcal/mol. These values are in good agreement with the data tabulated in the revised JANAF tables (1982), with those derived from new measurements of the photoionization threshold for the amidogen radical, and with those from independent measurements of the rate constants of the forward and back reactions. The Arrhenius rate expression derived for reaction (-1), $NH_2+H_2 \rightarrow NH_3+H$, is k/sub -/$_1$(T) = 5.38 x 10^{-11} exp(-6492/T) cm^3 $molecule^{-1}$ s^{-1} for the temperature range 900—1620 K. The estimated error in k/sub -/$_1$(T) is about +- 25%.

15465 **Vibrational and electronic spectroscopy of pyridine and benzene adsorbed on the Rh(111) crystal surface.** Mate, C.M.; Somorjai, G.A.; Tom, H.W.K.; Zhu, X.D.; Shen, Y.R. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **88**: No. 1, 441-450(1 Jan 1988). Contract AC03-76SF00098.

We report the vibrational and electronic spectra for pyridine and benzene adsorbed on the Rh(111) crystal surface obtained by high-resolution electron energy loss spectroscopy (HREELS). Low-energy electron diffraction (LEED), thermal desorption spectroscopy (TDS), and optical second harmonic generation (SHG) have also been used to provide complementary information. Pyridine adsorption on Rh(111) was studied over the 77—450 K temperature range. At 77 K, multilayers of pyridine are observed with a vibrational spectrum similar to that of liquid pyridine. Between 185 and 230 K, HREELS and TDS indicate that both physisorbed and chemisorbed pyridine species are present on the surface. The physisorbed species desorbs at 295 K, while the chemisorbed species is stable until it decomposes on the surface at 400 K. We propose that the chemisorbed species is an α-pyridyl complex as thermal desorption spectroscopy indicates partial dehydrogenation of this pyridine surface species. Electronic energy loss spectra for both benzene and pyridine adsorbed at 310 K show only a weak transition centered at ~4 eV. The absence of prominent $\pi \rightarrow \pi^*$ transitions, which are readily observed for multilayers of benzene adsorbed on Rh(111), implies that the π orbitals are strongly involved in the chemisorption bond of these molecules with the Rh(111) surface.

15466 **Ru L edge x-ray absorption studies of the electronic structure of $Ru_3(CO)_{12}$ adsorption and the formation of Ru—Cu bimetallics on Cu(111).** Sham, T.K.; Ohta, T.; Yokoyama, T.; Kitajima, Y.; Funabashi, M.; Kosugi, N.; Kuroda, H. (Department of Chemistry, Brookhaven National Laboratory, Upton, N.Y. 11973.). *Journal of Chemical Physics;* **88**: No. 1, 475-477(1 Jan 1988). Contract AC02-76CH00016.

Ru L/sub 2,3/ edge XANES (x-ray absorption near edge structure) together with AES (Auger electron spectroscopy) and LEED (low energy electron diffraction) studies of $Ru_3(CO)_{12}$ adsorbed on Cu(111) reveal the following: (a) $Ru_3(CO)_{12}$ adsorbs molecularly on Cu(111) at low temperature (approx. <-50°). (b) Upon electron bombardment, $Ru_3(CO)_{12}$ dissociates to form bare Ru aggregates which exhibit very broad Ru L/sub 2,3/ white lines and featureless absorption in the XANES spectrum indicating that the Ru atoms are not well ordered on the Cu(111) surface. (c) Annealing of the bare Ru aggregates on Cu(111) at 450 °C results in the formation of Cu/Ru bimetallic clusters in which the Ru atoms are in the core and exhibit bulk-like Ru L/sub 2,3/ XANES while the surface is covered with Cu atoms. Analysis of the Ru L_3 white line intensity indicates that charge redistribution in the Ru d band occurs upon the transformation from the bare Ru aggregates to the bimetallic Cu/Ru clusters on Cu(111).

15467 **Mechanisms controlling graphite furnace atomization and stabilization of beryllium.** Styris, D.L.; Redfield, D.A. (Pacific Northwest Lab., Richland, WA). *Analytical Chemistry;* **59**: No. 24, 2897-2903(15 Dec 1987). Contract AC06-76RL01830.

The real-time mass spectra of gas-phase species, produced in a graphite furnace containing beryllium analyte and a magnesium modifier, are obtained and used to elucidate mechanisms that control vaporization, atomization and stabilization. It is determined that free beryllium is produced from the thermal decomposition of adsorbed monomeric oxide. Beryllium is lost as polymeric oxides, carbides, cyanide, and cyanamide during the atomization phase. Stabilization occurs by dehydration of the dihydroxide, a mechanism that is identical with that responsible for stabilization of aluminum. Comparisons are made with mechanisms associated with atomization of aluminum.

15468 **Detection of aerosol formation in the effluent of a supercritical fluid chromatograph.** Goates, S.R.; Zabriskie, N.A.; Simons, J.K.; Khoobehi, B. (Brigham Young Univ., Provo, UT). *Analytical Chemistry;* **59**: No. 24, 2927-2930(15 Dec 1987). Contract FG22-83PC60807;FG22-86PC90534.

Supercritical fluid techniques continue to grow in importance in analytical chemistry, especially supercritical fluid chromatography. Accompanying this growth is the development of postcolumn detection methods, including flame ionization detection, inductively coupled plasma emission, mass spectrometry, and supersonic jet spectroscopy. In each of these detection methods, the behavior of the fluid at the point of decompression especially in regard to nucleation processes, can severely affect the performance of the detector. Solute aggregation is the major contributor to the spiking which has been observed with flame ionization detection, but, as the authors discuss later in this paper, erratic spitting of large aerosol droplets can occur with extended restrictors and will also produce noise spikes. However, even fine aerosol mists can severely interfere with spectroscopic detection, not only increasing the noise level but also inhomogeneously broadening spectral lines; thus the characterization of aerosol formation has been particularly important to their investigation of supersonic jet spectroscopy with supercritical fluid carriers. They report here the conditions for aerosol formation in the effluent jet, as monitored by laser-light scattering, for five fluids, which cover a wide range of critical constants and chemical properties.

15469 **Analysis of the infrared and raman spectra of the formic acid dimer ($HCOOH)_2$.** Chang, Y.T.; Yamaguchi, Y.; Miller, W.H.; Schaefer, H.F. III. (Lawrence Berkeley Lab., CA). *Journal of the American Chemical Society;* **109**: No. 24, 7245-7253(25 Nov 1987). Contract AC03-76SF00098.

Ab initio molecular quantum mechanical methods have been used to study the formic acid dimer and several isotopomers. Structures and harmonic vibrational frequencies have been predicted for the monomer, the equilibrium dimer, and the transition state for simultaneous two-hydrogen transfer. In an attempt to systematize results obtained at various levels of theory, three different basis sets were used: minimum, double-zeta (DZ), and double-zeta plus polarization (DZ+P). The predicted self-consistent-field (SCF) dissociation energies D/sub e/ are 15.1 (minimum basis), 19.3 (DZ), and 14.3 (DZ+P) kcal/mol. Further consideration of zero-point vibrational energies and finite temperature effects allows a comparison with several experimental values for ΔH_{300}. The infrared and Raman intensities (as well as the vibrational frequencies themselves) are compared with available experimental results. Where comparison is possible, the agreement is generally good. An exception occurs for ν_{15}, the O-D stretch of the $(HCOOD)_2$ molecule, where it is concluded that the experimental analysis may be incorrect.

15470 **Phases in the system XeF_2/XeF_5AsF_6 and structural vibrational evidence for the following ionization pathway: $XeF_2 \rightarrow XeF^+ + F^-$.** Zemva, B.; Jesih, A.; Templeton, D.H.; Zalkin, A.; Cheetham, A.K.; Bartlett, N. (Lawrence Berkeley Lab., CA). *Journal of the American Chemical Society;* **109**: No. 24, 7420-7427(25 Nov 1987). Contract AC03-76SF00098.

A fusion temperature versus composition curve has been obtained for the system XeF_2/XeF_5AsF_6. X-ray single-crystal and powder diffraction methods have been used in combination with Raman spectroscopy to characterize the various phases that are formed. The fusion temperature/composition curve indicates compound formation at XeF_2 to $XeHeF_5AsF_6$ ratios (fusion temperature in parentheses): 1:2 (89.5 °C), 2:1 (39.5 °C), and 3:1 (74.0 °C). Other simple integer combinations are also suggested at the ratios 1:1 (56.5 °C) and 3:2 (56.0 °C).

15471 **Homogeneous catalysis of the reppe reaction with iron pentacarbonyl: the production of propionaldehyde and 1-propanol from ethylene.** Massoudi, R.; Kim, J.H.; King, R.B.; King, A.D. Jr. (Univ. of Georgia, Athens). *Journal of the American Chemical Society;* **109**: No. 24, 7428-7433(25 Nov 1987). Contract AS09-76ER00933.

The Reppe hydroformylation of ethylene to produce propionaldehyde and 1-propanol in basic solutions containing $Fe(CO)_5$

as a catalyst has been studied under carefully controlled conditions at temperatures ranging from 110 to 140 °C. Propionaldehyde is the principal product formed when NaOH is used as the base. The rate of reaction is found to increase with ethylene concentration and is second order with respect to $Fe(CO)_5$. The reaction is inhibited by CO. The increase in reaction rate with temperature corresponds to an activation energy of 31 kcal/mol. Infrared spectra indicate that $HFe(CO)_4$-and $Fe(CO)_5$ are present in the solution phase under reaction conditions. The experimental results are shown to be consistent with a mechanism in which the rate-determining step involves a binuclear iron carbonyl derivative. The substitution of $(C_2H_5)_3N$ for NaOH facilitates the reduction of propionaldehyde to form 1-propanol but results in a slower rate for the overall reaction.

15472 **ESR characterization of ring-closed oxirane radical cations via a novel alternating line width effect.** Williams, F.; Dai, S.; Snow, L.D.; Qin, X.Z.; Bally, T.; Nitsche, S.; Haselbach, E.; Nelsen, S.F.; Teasley, M.F. (Univ. of Tennessee, Knoxville). *Journal of the American Chemical Society;* **109**: No. 24, 7526-7528(25 Nov 1987).

There is considerable experimental evidence supported by numerous theoretical studies to show that the radical cation formed from oxirane under both gas-phase and solid-state conditions is the planar C...C ring-opened oxallyl isomer. In fact, the low barrier to the isomerization usually dictates that only the ring-opened form can be detected spectroscopically from monocyclic and bicyclic oxiranes at 77 K. These elusive cyclic cations should be accessible, however, in polycyclic oxiranes where steric constraints prevent C...C opening of the oxirane ring, and here the authors report the first ESR characterization of ring-closed oxirane cations with a one-electron C-C bond.

15473 **Process design and evaluation of a continuous chemical plant for the singlet oxygen-iodine laser.** Demyanovich, R.J.; Lynn, S. (TERA Corp., 2150 Shattuck Avenue, Berkeley, CA 94704). *Fujitsu Scientific and Technical Journal;* **12**: No. 3, 488-501(Nov 1987).

Process designs were evaluated for the continuous, large-scale generation of singlet delta oxygen for use in a chemical oxygen-iodine laser. The excited singlet oxygen is generated from the chemical reaction of chlorine gas with basic hydrogen peroxide. The chemical reaction also produces a large waste brine stream that can be controlled by recycling through a chloralkali cell, which regenerates the reactants Cl/sub 2/ and NaOH. To prevent deactivation of this excited oxygen, a large excess of hydrogen peroxide is typically used to change the reaction mechanism. This use of excess hydrogen peroxide or nonstoichiometric generation leads to substantial increase in capital and operation cost when compared with theoretic stoichiometric (no excess) generation.

15474 **X-Ray absorption edge determination of the oxidation state and coordination number of copper: application to the type 3 site in rhus vernicifera laccase and its reaction with oxygen.** Kau, L.S.; Spira-Solomon, D.J.; Penner-Hahn, J.E.; Hodgson, K.O.; Solomon, E.I. (Stanford Univ., CA). *Journal of the American Chemical Society;* **109**: No. 21, 6433-6442(14 Oct 1987).

Cu X-ray absorption edge features of 19 Cu(I) and 40 Cu(II) model complexes have been systematically studied and correlated with oxidation state and geometry. Studies of Cu(I) model complexes with different coordination number reveal that an 8983-8984-eV peak (assigned as the Cu 1s → 4p transition) can be correlated in energy, shape, and intensity with ligation and site geometry of the cuprous ion. These Cu(I) edge features have been qualitatively interpreted with ligand field concepts. Alternatively, no Cu(II) complex exhibits a peak below 8985.0 eV. The limited intensity observed in the 8983-8985-eV region for some Cu(II) complexes is associated with the tail of an absorption peak at ~ 8986 eV which is affected by the covalency of the equatorial ligands. These models studies allow accurate calibration of a normalized difference edge procedure which is used for the quantitative determination of Cu(I) content in copper complexes of mixed oxidation state composition. This normalized difference edge analysis is then used to quantitatively determine the oxidation states of the copper sites in type 2 copper-depleted (T2D) and native forms of the multicopper oxidase, Rhus vernicifera laccase. The type 3 site of the T2D laccase is found to be fully reduced and stable to oxidation by O_2 or by 25-fold protein equivalents of ferricyanide, but it can be oxidized by reaction with peroxide. The increase in intensity of the 330-nm absorption feature which results from peroxide titration of T2D laccase is found to correlate linearly with the percent of oxidation of the binuclear copper site.

15475 **Intermolecular vinylic C-H bond activation by a double bonded organoditantalum complex.** Ting, C.; Messerle, L. (Univ. of Iowa, Iowa City). *Journal of the American Chemical Society;* **109**: No. 21, 6506-6508(14 Oct 1987). Contract FG22-85PC80513.

Intermolecular C-H bond activation of hydrocarbons, in particular alkanes, by organotransition-metal species is a reaction of fundamental modeling importance for future efforts at hydrocarbon functionalization. Examples of hydrocarbon oxidative addition and of alkyl/hydrocarbon exchange have been reported with organometallic complexes of the late transition metals, metals from groups 6 and 7, and the lanthanides/actinides, but there are no examples of intermolecular alkane or vinylic C-H bond activation with metals from groups 4 and 5. Intermolecular vinylic C-H bond activation is an underrepresented area in hydrocarbon C-H bond activation by organometallics, with few mononuclear and dinuclear, as opposed to polynuclear, examples. The kinetic and thermodynamic differences between C-H activation involving the low-valent late metal and the high-valent lanthanide/actinide complexes suggest that intervening metal complexes, such as intermediate valent group 5 species, may exhibit optimal properties in C-H activation; the propensity for electronic unsaturation in complexes of these metals may lead to successful functionalization studies. Intramolecular ligand metalations and arene H/D exchange reactions with Nb and Ta complexes have been reported, and in principle intermolecular vinylic and alkane C-H bond reactivity should be feasible. They wish to report the first examples of isolable intermolecular vinylic C-H activation by an early transition-metal (groups 4 and 5) organometallic and by a metal-metal multiply bonded complex.

15476 **Hydrogen atom transfer reactions of transition-metal hydrides. Utilization of a radical rearrangement in the determination of hydrogen atom transfer rates.** Bullock, R.M.; Samsel, E.G. (Brookhaven National Lab., Upton, NY). *Journal of the American Chemical Society;* **109**: No. 21, 6542-6544(14 Oct 1987). Contract AC02-76CH00016.

The reaction of a transition-metal hydride with an unsaturated substrate is a critical step in several catalytic reactions. Commonly accepted mechanisms for homogeneous hydrogenation and hydroformylation have traditionally involved even-electron intermediates conforming to the 16- and 18-electron rule. Recently, kinetic and spectroscopic (CIDNP) evidence has been reported in support of odd-electron pathways for reactions of metal hydrides with substituted styrenes, anthracenes, allenes, and conjugated dienes, all of which form stabilized (benzylic or allylic) radicals. The authors report a new approach, in which metal hydrides are reacted with vinylcyclopropanes, which contain a radical clock.

15477 **Kinetic spectroscopy using a color center laser.** Stephens, J.W.; Hall, J.L.; Yan, W.B.; Solka, H.; Richnow, M.L.; Curl R.F. Jr.; Glass, G.P.; Tittel, F.K. (Rice University, Houston, TX. 77251). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 391-393(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

Infrared kinetic spectroscopy has been used to study the ethynyl radical, C_2H. In this work, three new absorption bands in the infrared have been discovered and the reaction rate constants of C_2H with O_2, H_2, and NO have been measured. (AIP)

15478 **ESR study of the dissociation of hydroxyl protons in hydroxyl radical adducts to pyridinedicarboxylic acids.** Taniguchi, H. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **91**: No. 20, 5213-5217(24 Sep 1987).

The pK/sub a/ values for OH proton dissociation in the hydroxyl radical adducts to pyridinedicarboxylic acids have been determined to be 13.0-15.2 in the H/sub -/ basicity scale according to

in situ radiolysis-steady-state ESR methods. The OH or O^- radicals were found to add to ortho and meta positions with respect to a ring nitrogen atom in 2,3-, 3,4-, 3,5-, 2,4-, 2,5-, 2,6-, and 1,4-dihydro-4-oxo-2,6-pyridinedicarboxylic acids. The positions of electron-withdrawing carboxyl groups and a ring nitrogen atom had an effect both upon ESR parameters in acid form and upon pK/sub a/ values. Substrate radicals that have a nitrogen atom at the ortho position with respect to the site of OH addition gave larger g values, larger methylenic and ortho proton hyperfine coupling, larger nitrogen hyperfine coupling, and smaller hydroxyl proton hyperfine coupling than those having nitrogen at the meta position. These differences were explained qualitatively. The presence of a ring nitrogen atom affects g factors additively with increments of +0.00046 and -0.00019 for ortho and meta substituents, respectively. Remarkable changes in ESR parameters with basicity were found in the dominant methylenic proton and several ring proton and nitrogen hyperfine coupling constants upon the dissociation of the OH proton. The pK/sub a/ values are lower by 0.4-1.1 units than corresponding hydroxycyclohexadienyl radicals of benzenedicarboxylic acids, because of an electron-withdrawing character of a ring nitrogen atom. The pK/sub a/ values of radicals with carboxyl groups at the ortho position are higher than those of radicals without a carboxyl group at the ortho position, suggesting the existence of specific interactions between the ortho carboxyl and OH or O^- groups as is the case in hydroxycyclohexadienyl radicals of carboxylated benzenes.

15479 **Addition and dissociation reaction H + CO reversible HCO. 1. Theoretical RRKM studies.** Wagner, A.F.; Bowman, J.M. (Argonne National Lab., IL). *Journal of Physical Chemistry;* **91**: No. 201, 5314-5324(24 Sep 1987). Contract W-31-109-ENG-38.

RRKM calculations of the thermal addition and dissociation rate constants are carried out on the Harding surface for HCO. Structures, frequencies, and energetics at the stationary points on the surface are presented for HCO and DCO. Due to the relatively weak H-CO bond (bond energy of about 16 kcal/mol) and the few degrees of freedom in HCO, the spacing between the vibrational states of the metastable HCO* is quite large. This motivates a form of RRKM theory in which metastable HCO* is explicitly considered to exist only at isolated vibrational resonance energies and all addition and dissociation dynamics is controlled by these isolated resonance states. The rate constant calculations focus on the implications of this isolated resonance model. Several experiments to test the model are indicated. Among the major conclusions of the study are (1) a standard treatment of tunneling cannot by included in the calculations, (2) explicit summation over total angular momentum must be included in the calculations, (3) interesting isotope effects in addition are predicted in the low-pressure limit of the rate constants, and (4) measurable recrossing effects are predicted in the approach to the high-pressure limit of the rate constants. In the following paper, the isolated resonance RRKM calculations are directly and generally favorably compared to the existing low-pressure measurements for both thermal addition and dissociation.

15480 **Addition and dissociation reaction H + CO ⇌ HCO. 2. Experimental studies and comparison with theory.** Timonen, R.S.; Ratajczak, E.; Gutman, D.; Wagner, A.F. (Illinois Institute of Technology, Chicago). *Journal of Physical Chemistry;* **91**: No. 201, 5325-5332(24 Sep 1987). Contract AC02-78ER14945.

Directly measured low-pressure thermal HCO dissociation rate constants and isotope effect are presented for the first time. The temperature range of the measurements is 637-832 K. A theoretical model developed in the preceding paper is found to be highly consistent with these results and with all available H + CO thermal addition rate constant measurements. The calculations are used to extend the measured dissociation rate constant to combustion temperatures. The calculated low-pressure dissociation rate constant k_1 in various buffer gases is accurately represented from 300 to 3000 K by $k_1(Ar) = 3.09 \times 10^{-7}T^{-1}e/sup -17.0/RT/$, $k_1(He) = 3.80 \times 10^{-7}T^{-1}e/sup -17.1/RT/$, $k_1(N_2) = 3.07 \times 10^{-7}T^{-1}e/sup -17.0/RT/$, and $k_1(H_2) = 5.79 \times 10^{-7}T^{-1}e/sup -17.0/RT/$, where k_1 is in cm^3/(molecule s) and R is in kcal/(mol deg). The calculations suggest that (ΔE)/sub tot/, the average energy transfer between metastable HCO* and the buffer gas, varies between -40 and -50 cm^{-1} for buffer gases N_7, H_2, He, and Ar.

15481 **Homogeneity ranges, order-disorder transition, and structures of the nonstoichiometric monosulfides of zirconium.** Kim, S.J.; Nguyen, T.H.; Franzen, H.F. (Iowa State Univ., Ames). *Journal of Solid State Chemistry;* 70: No. 1, 88-92(Sep 1987). Contract W-7405-ENG-82.

Two structures are known for defect zirconium monosulfides, the hypostoichiometric sulfide with the WC-type structure and the hyperstoichiometric sulfide with a NaCl-type superstructure. The approximate (+/- 0.02 for S/Zr) homogeneity limits for the phases were determined for carefully equilibrated samples cooled to room temperature. The order-disorder transition in hyperstoichiometric monosulfide was observed to occur at about 1250°C (+/- about 20°C), and the refined superstructure was determined to be the $CdCl_2$ vacancy ordering by Rietveld full-profile analysis.

15482 **Ternary mutual diffusion coefficients of NaCl-$SrCl_2$-H_2O at 25°C. 1. Total concentrations of 0.5 and 1.0 mol.dm^{-3}.** Rard, J.A.; Miller, D.G. (Lawrence Livermore National Lab., CA). *Journal of Physical Chemistry;* **91**: No. 17, 4614-4620(13 Aug 1987). Contract W-7405-ENG-48.

Mutual diffusion coefficients have been measured for aqueous NaCl-$SrCl_2$ mixtures at 25°C by using free-diffusion Rayleigh interferometry. These diffusion experiments were done at total molarities of 0.5 and 1.0 mol x dm^{-3} and with molarity fractions of 1/3, 1/2, and 2/3. Main-term diffusion coefficients for NaCl and $SrCl_2$ show a 10-15% variation with concentration and composition. Coupled diffusion is important for these systems, with cross-term diffusion coefficients being 6.5-36% as large as their corresponding main terms. At a constant molarity ratio, doubling the concentration causes cross-term diffusion coefficients to increase. Attempts to estimate the ternary solution diffusion coefficients from those of their corresponding binary solutions or from the ternary solution analogues of the Nernst-Hartley equation do not yield particularly accurate results.

15483 **Excess electron mobility in hydrocarbon liquids at high pressure.** Munoz, R.C.; Holroyd, R.A.; Itoh, K.; Nakagawa, K.; Nishikawa, M.; Fueki, K. (Brookhaven National Lab., Upton, NY). *Journal of Physical Chemistry;* **91**: No. 17, 4639-4643(13 Aug 1987). Contract AC02-76CH00016.

Excess electron mobilities (μ) are reported as a function of pressure (1-2500 bar) and temperature (20-120 °C) for n-pentane, 3-methylpentane, and cyclopentane for which μ at 20 °C and low pressure is ≲ 1.0 cm^3/(V x s), and for 2,2-dimethylbutane (2,2-DMB) for which μ ~ 10 cm^3/(V x s) at 1 atm and room temperature. For the first three liquids the mobility decreases with pressure at all temperatures studied. The results are interpreted in terms of an equilibrium between quasi-free and trapped electrons, and application of pressure shifts the equilibrium in favor of trapped electrons thus lowering the mobility. The volume changes, associated with trapping, which are of the order of -20 cm^3/mol at standard conditions are attributed to electrostriction of the solvent by the trapped (or localized) electron. For 2,2-DMB, the mobility increases with increasing pressure at low temperature and decreases with pressure at high temperature. This behavior is not understood but suggests that traps are unimportant in 2,2-dimethylbutane.

15484 **Viscosities of binary and ternary mixtures of polyaromatic hydrocarbons.** Byers, C.H.; Williams, D.F. (Chemical Technology Div., Oak Ridge National Lab., Oak Ridge, TN 37831). *Journal of Chemical and Engineering Data;* **32**: No. 3, 349(Jul 1987). Contract AC05-84OR21400.

Experimental measurements of the viscosities of the three binary-mixture combinations of the toluene/tetralin/1-methylnaphthalene system were performed over the entire concentration range for various temperatures ranging from 298 to 498 K. Viscosities were also determined for an equimolar mixture of the three components and for the binary naphthalene/tetralin system. Finally, the polar phenol/picoline mixture was found to have interesting associative properties. The viscosity data determined have an experimental uncertainty of 1.1%. The viscosity correlation of Mc Allister gave excellent representations of both binary and ternary data.

15485 Viscosities of pure polyaromatic hydrocarbons. Byers, C.H.; Williams, D.F. (Chemical Technology Div., Oak Ridge National Lab., Oak Ridge, TN 37831). *Journal of Chemical and Engineering Data;* **32**: No. 3, 344-348(Jul 1987). Contract AC05-84OR21400.

Experimental measurements of the viscosities of eight aromatic and polyaromatic compounds are reported for the temperature range 298-498 K. These viscosity data, with an experimental uncertainty of 0.5%, represent a substantial expansion of the data base for some materials (such as toluene) and establish a data base for such compounds as picoline and quinoline. A comparison of these data with the results of the Morris correlation and the equation of van Veizen et al. gave average errors in the 15% range.

15486 High-temperature diffusion of hydrogen, carbon monoxide, and carbon dioxide in liquid n-heptane, n-dodecane, and n-hexadecane. Matthews, M.A.; Rodden, J.B.; Akgerman, A. (Dept. of Chemical Engineering, Texas A and M Univ., College Station, TX 77843). *Journal of Chemical and Engineering Data;* **32**: No. 3, 319-322(Jul 1987).

Mutual diffusion coefficients at infinite dilution have been measured for hydrogen, carbon monoxide, and carbon dioxide in the solvents n-heptane, n-dodecane, and n-hexadecane. The data cover the temperature range from 25 to 293°C and pressures of 1415 and 3450 kPa. The Taylor dispersion method was used for diffusion measurements. It was found that the Sovova correlation for diffusion of dissolved gases in liquids failed to predict diffusivities at temperatures above ambient. A free-volume approach to correlation is indicated instead.

15487 Determination of phase transformation depth profiles with synchrotron radiation. Keefer, K.D.; Michalske, T.A. (Sandia National Labs., Albuquerque, NM 87185). *Journal of the American Ceramic Society;* **70**: No. 4, 227-231(Apr 1987). Contract AC04-76DP00789.

The transformation of tetragonal zirconia to monoclinic in glass-ceramic as a function of depth from a fracture surface was measured by X-ray diffraction employing synchrotron radiation. The large number of photon energies which can be used in such an experiment permit rigorous testing of models of the transformation zone. A crack plane intersection model has been developed to interpret the observations for two phase-transformation-toughened glass-ceramics of grossly different microstructures.

15488 Comparison of sodium leaching rates from a $Na_2O.3SiO_2$ glass in H_2O and D_2O. Pederson, L.R. (Pacific Northwest Lab., Richland, WA, USA). *Physics and Chemistry of Glasses;* **28**: No. 1, 17-21(Feb 1987).

An isotope effect was observed in pH-stat experiments when comparing the leaching rates of sodium from sodium trisilicate glass in deuterated and protonated water. The magnitude of the effect, defined as the ratio of leaching rates in D_20 to those in H_20, was 0.70 + - 0.07. The isotope effect persisted at this magnitude both in the initial stages of sodium ion release, usually considered to be controlled by ion interdiffusion, and in later stages, usually attributed to dissolution of the silicate matrix. No temperature dependence was apparent. While diffusion processes quite probably influence initial leaching rates, they are unlikely to give rise to the observed isotope effect. Rather, results can be explained using transition state theory involving a proton transfer step in the hydrolysis of the silicate matrix. Matrix hydrolysis is proposed as an important precursor to alkali release, initially as well as in later stages of the reaction.

15489 Synthesis and characterization of zirconium-antimony binary and interstitial ternary intermetallic compounds. Garcia, E. Ames, IA; Iowa State Univ. (1987). 211p. University Microfilms Order No. 87-21,885.Contract W-7405-ENG-82.

Thesis (Ph.D).

A family of Zr_5Sb_3Z compounds, Z = C, O, Al, Si, P, S, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se, have been synthesized in the Mn_5Si_3 structure. The Z element occupies the center of confacial trigonal antiprisms of zirconium atoms. Antimony can also occupy the interstitial site, and the binary compound has a homogeneity range Zr_5Sb/sub 3.0/ to Zr_5Sb/sub 3.4/. The compounds were mainly prepared by arc-melting or powder sintering. Temperatures in excess of 1100°C were needed to provide adequate reaction rates for the sintering experiments. Isothermal vapor transport reactions, $1100 < T < 1300$°C, with iodine as a transporting agent were used to ensure complete reaction, but provided no single crystals. Reactions using Zn or In as a solvent yielded single crystals. Reactions using Zn or In as a solvent yielded single crystals of a size suitable for physical property measurements. Structural refinements were carried out for the compounds Zr_5Sb_3Al, Zr_5Sb_3Si, Zr_5Sb_3S, Zr_5Sb_3Fe, Zr_5Sb_3(Fe/sub 2/3/In/sub 1/3/). Extended-Hueckel band calculations were carried out on Zr_5Sb_3, Zr_5Sb_3S, and Zr_5Sb_3Fe in order to rationalize the ability of Zr_5Sb_3 to interstitially incorporate this remarkable array of chemically diverse elements.

15490 Redox kinetics and oxygen diffusion in a borosilicate melt. Schreiber, H.D.; Kozak, S.J.; Fritchmann, A.L.; Goldman, D.S.; Schaeffer, H.A. (Virginia Military Inst., Lexington, USA; Washington and Lee Univ., Lexington, VA, USA; Virginia Military Inst., Lexington, USA; Vanderbilt Univ., Nashville, TN, USA. Dept. of Chemistry; Battelle Pacific Northwest Lab., Richland, WA, USA). *Physics and Chemistry of Glasses;* **27**: No. 4, 152-177(Aug 1986).

Redox kinetics and oxygen diffusion in a borosilicate melt are examined, with a view to understanding the refining of glass melts for the immobilization of nuclear waste. A mathematical model for redox kinetics controlled by oxygen diffusion through a glass forming melt is developed, which is then tested quantitatively in a borosilicate melt. The temperature dependent diffusion coefficient of oxygen in a reference borosilicate liquid is determined. The application of these findings to redox equilibrium of multivalent elements in a borosilicate melt is discussed with respect to immobilization of nuclear waste. (U.K.).

15491 Diffusion of ^{18}O in CoO in air. Routbort, J.L.; Rothman, C.J. (Argonne National Lab., IL, USA). *Journal of Physics and Chemistry of Solids;* **47**: No. 10, 993-998(1986). Contract W-31-109-ENG-38.

The diffusion coefficient of ^{18}O in CoO single crystals has been measured in the temperature range of 1100-1500°C in air (psub(O2) 2 x 10^4 Pa). The penetration profiles were measured by secondary ion mass spectrometry, and diffusion coefficients could be obtained if evaporation of the sample and exchange of the diffusant with the ambient were taken into account. The diffusion coefficient is given by D (86 +- 30) exp (-431 +- 5 kJ mol^{-1}/RT) cm^2s^{-1}. The activation energy for diffusion agrees with the activation energy obtained from deformation studies. The heat of sublimation calculated from the evaporation rate, 510 kJ mol^{-1}, agrees with a theoretical estimate.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 14410, 14896, 15051, 15279, 15423

15492 (LBL—24522) The effect of suspended solids on mass transfer in electrochemical systems. Andersen, P.K.; Tobias, C.W.; Muller, R.H. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005269/JAW.

Enhancement of mass-transfer rates by suspended, inert solid particles (glass or polymer particles) was studied using a rotating-disk electrode (RDE). The effects of solids concentration, particle size, and shear rate on limiting currents were measured for the reduction of ferricyanide ion. The data show evidence of two different transport mechanisms, which depend on particle size. For particles ≦ the thickness of the mass-transfer boundary layer, the Sherwood number Sh is a function of a Peclet number Pe: Sh = αPe/sup m/, where α and m are functions of the solids volume fraction. To apply to the RDE system, it was necessary first to solve the transport equations assuming that the diffusivity varies with radial position on the disk. The analysis yields I/sub L/*/I/sub L/ proportional to [αPe/sub R//sup m/]/sup 2/3/ where I/sub L/*/I/sub L/ is the ratio of limiting current obtained with particles to the limiting current without, and Pe/sub R/ is the Peclet number evaluat-

ed at the outer radius of the electrode (r = R). For particles much larger than the thickness of the mass-transfer boundary layer, transport enhancement results from a particle-depleted "slip" layer at the electrode surface. The shear rate is higher inside the slip layer than in a homogeneous suspension; this thins the mass-transfer boundary layer. If this layer is of constant thickness, and the r- and θ-velocity gradients are increased by the same factor, it can be shown that the limiting current is related to the torque required to turn the disk: I/sub L/*/I/sub L/ = [T*/T]/sup 1/3/ where T* and T are the torques on the disk with and without particles, respectively. Measurements show that this equation underestimates the limiting current by as much as 60%, while failing to account for the observed increase in current density with electrode size. The torque measurements were also useful in estimating the mixing-power requirements.

4005 Photochemistry

REFER ALSO TO CITATION(S) 14410, 14710, 15348, 15442, 15500, 15525

15493 **(DOE/ER/13363—T1) Product kinetic and internal energy distributions via velocity-aligned Doppler spectroscopy: Technical report, May 1985-January 1987.** Wittig, C. (University of Southern California, Los Angeles (USA). Dept. of Chemistry). 1987. Contract FG03-85ER13363. 31p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88003510/JAW.

We developed a method of sub-Doppler resolution spectroscopy that is useful for determining kinetic energy distributions. With 'conventional' Doppler spectroscopy, it is almost impossible to obtain an accurate distribution from a line profile, even with the highest resolution, except when the distribution is quite simple (e.g., a delta function). This is due to the lineshape deriving from velocity components along the wave-vector of the probe radiation, k/sub probe/. However, by choosing only those species whose velocities are essentially parallel (or antiparallel) to k/sub probe/, this handicap is overcome. Here, one obtains the kinetic energy distribution along k/sub probe/, and the resolution is limited only by our ability to reject species with velocity components perpendicular to k/sub probe/. This rejection is done by spatial and temporal discrimination, using counterpropagating, overlapped, pulsed photolysis and probe sources. At long delays, molecules are detected which are aligned with k/sub probe/. We call the method velocity-aligned Doppler spectroscopy (VADS). We have perused several cases involving photodissociation of small molecules, in each case detecting H-atoms using sequential 2-photon ionization via Lyman-α. We discern structure in the kinetic energy distribution which is attributed to internal excitation of the 'other' fragment, and resolution is limited by the dye laser bandwidth. In the case of HBr, we resolve the Br spin-orbit states, and with H_2S, we resolve the SH vibrational levels. 38 refs., 7 figs.

15494 **(PB—88-123963/XAB) Photocatalytic formation of hydrogen peroxide.** Bahnemann, D.W.; Hoffman, M.R.; Hong, A.P.; Kormann, C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1987. 15p. (EPA—600/D-87/329). NTIS, PC A03/MF A01.

Pub. in Chemistry of Acid Rain, Sources and Atmospheric Processes, American Chemical Society Symposium Series 349, Chapter 10, 120-132 1987.

The two-electron reduction of molecular oxygen to hydrogen peroxide can be catalyzed by semiconductor particles in the presence of visible and near-UV light. While very high quantum yields for the process are generally observed, rather low steady-state concentrations of H_2O_2 are also often encountered. Detailed mechanisms are presented to explain these experimental findings. Semiconducting metal oxide particles are abundant in hydrometers and surface waters, and the environmental impact of a photocatalytic formation of H_2O_2 in natural systems is discussed.

15495 **Detection of transient fluorine atoms.** Loge, G.W.; Nereson, N.; Fry, H.A. (Chemical and Laser Sciences Division, Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* 160: No. 1, 683-686(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

A KrF laser with a fluence of 50 mJ/cm^2 was used to photolyze either uranium hexafluoride or molecular fluorine, yielding a transient number density of fluorine atoms. The rise and decay of the atomic fluorine density was observed by transient absorption of a 25-μm Pb-salt diode laser. To prevent the diode laser wavelength from drifting out of resonance with the atomic fluorine line, part of the beam was split off and sent through a microwave discharge fluorine atom cell. This allowed a wavelength modulation-feedback technique to be used to lock the diode laser wavelength onto the atomic line. The remaining diode laser beam was made collinear with the excimer laser beam using a LiF window with a 45° angle of incidence to reflect the infrared beam while transmitting most of the uv beam. Using this setup along with a transient digitizer to average between 100 and 200 transient absorption profiles, fluorine atom number densities on the order of 10^{14} cm^{-3} in a 1.7 m pathlength were detected. The signal observed were about a factor of two less than expected from known photolysis and atomic fluorine absorption cross-sections.

15496 **Photophysical behavior in spread monolayers. Dansyl fluorescence as a probe for polarity at the air-water interface.** Grieser, F.; Thistlethwaite, P.; Urquhart, R.; Patterson, L.K. (Univ. of Melbourne, Parkville, Australia). *Journal of Physical Chemistry;* 91: No. 201, 5286-5291(24 Sep 1987).

The emission spectrum of N-[5-(dimethylamino)naphthalene-1-sulfonyl]dihexadecylamine (dansyldihexadecylamine) in monolayers at the air-water interface has been studied. In some cases sudden shifts in the dansyl emission can be correlated with particular features of the surface pressure-area isotherms. These spectral shifts can be explained in terms of a change in the conformation of the head group on the surface and with aggregation of the dansyldihexadecylamine. In other cases the dansyl emission shows a blue shift with increasing compression that can be associated with reduced head-group hydration.

15497 **Additive effect on the CIDNP, cage effect, and exit rate of micellized radical pairs.** Turro, N.J.; Zimmt, M.B.; Lei, X.G.; Gould, I.R.; Nitsche, K.S.; Cha, Y. (Columbia Univ., New York, NY). *Journal of Physical Chemistry;* 91: No. 17, 4544-4548(13 Aug 1987).

The effects of additives on the recombination efficiency and exit rates of micellized benzyl radicals have been studied by steady-state CIDNP, steady-state product analysis, and time resolved optical absorption techniques. The results indicate that the efficiency of triplet geminate pair recombination increases monotonically as the micellar volume increases. Aggregation numbers of SDS micelles were deduced as a function of additive concentration from CIDNP measurements and were found to be consistent with literature values.

15498 **Distant homology between yeast photoreactivating gene fragment and human genomic digests.** Meechan, P.J.; Milam, K.M.; Cleaver, J.E. (Lab. of Radiobiology and Environmental Health, Univ. of California, San Francisco, CA 94143). pp 37 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Hybridization of DNA coding for the yeast DNA photolyase to human genomic DNA appears to allow one to determine whether a conserved enzyme is coded for in human cells. Under stringent conditions (68°C), hybridization is not found between the cloned yeast fragment (YEp13-phr1) and human or chick genomic digests. At less stringent conditions (60°C), hybridization is observed with chick digests, indicating evolutionary divergence even

among organisms capable of photo-reactivation. At 50°C, weak hybridization with human digests was observed, indicating further divergence from the cloned gene. Data concerning the precise extent of homology and methods to clone the chick gene for use as another probe are discussed.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 14160, 17160

15499 **(INIS-mf—10771) Grafting and polymerisation processes induced by electron beams for antistatic treatment and hydrophilation of polyester textiles with polyethylene glycol dimethacrylates.** Clauss, B. (Stuttgart Univ. (Germany, F.R.). Fakultaet 3 - Chemie). 15 Dec 1986. 144p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751502/JAW.

According to dosimetric measurements on various textiles, the penetration behaviour of accelerated electrons in textile substrates corresponds to that found for homogeneous foils. A clear relationship is given between depth of penetration and degree of ionisation. Infrared spectroscopic investigation of the homopolymerisation of polyethylene glycol dimethacrylates induced by radiation makes it clear that cross-linked polymers are formed if the dose is increased. This effect can be supported by the addition of multifunctional acrylates. The measurement of bending stiffness proved to be a useful method for distinguishing between homopolymers and grafted polymers. It was found during comparative measurements on glass fibre and polyester weaves that methacrylates can only be changed to polyesters at a high dose (100 kGy). In the treatment of polyester textiles induced by electron beams, the length of the ethylene glycol chain in the monomer proved to be an important factor. With increasing length of chain, better degrees of fixing, better antistatic effects and better cross-linking properties are found. The limit is reached at a chain length of 12. The appropriate monomer (polyethylene glycol-600-dimethacrylate) gives surfaces resistances of 10/sup 11/ ohms. The spread of a drop of water on the textile surface occurs in less than 2 seconds. The antistatic effect of the polymer is based on water adsorption at the textile surface.

15500 **(INIS-mf—10776) Photochemical and radiation chemistry investigations of reaction kinetics of dissolved electrons in water and ammonium-water mixtures.** Telser, T. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemie). 13 Feb 1986. 135p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751507/JAW.

In the reaction of hydrated electrons in aqueous alkaline solutions, an intermediate product is observed. In this work, this intermediate product was determined to be a long life photoactive product in double flash experiments, which reacts at a speed constant K = 1 x 10/sup 9/ M/sup -1/s/sup -1/ in a reaction of the 2nd order. It is formed in a reaction of the 1st order with reference to the electron concentration (e /sub aq//sup -/ -> X, 2X -> H/sub 2/). The alkaline metal cations of the solution appear as reaction partners of the hydrated electrons. The hydrated metal atoms formed were observed in the UV spectrum as absorpton bands at 270 nm. Pulse radiolytic measurements confirm the conclusions of the photochemical experiments.

15501 **Thermally activated release of stored chemical energy in cryogenic media.** Carpenter, J.M. (Argonne National Lab., IL, USA). *Nature (London);* **330**: No. 6146, 358-360(26 Nov 1987).

We have observed very rapid spontaneous heating of the cold solid methane moderator when irradiated by fast neutrons at low temperatures in the Intense Pulsed Neutron Source. We have also induced smaller rapid heat releases - both by slowly warming irradiated methane and by diminishing the effectiveness of cooling. An explanation for these observations is that energy stored in the form of reactive species (H, CH/sub 3/,...) accumulates in solid methane irradiated at low temperatures, and is released by thermally activated diffusion and subsequent reaction. During irradiation, the density of reactive species can build up sufficiently to become unstable as the rate of heat release due to recombination exceeds the rate of heat loss to the cooled surrounding.

15502 **Pulse radiolytic study of the acid dissociation of OH protons in radicals related to salicylic acid.** Sun, Q.; Schuler, R.H. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **91**: No. 17, 4591-4595(13 Aug 1987).

The deprotonation of carboxylated benzosemiquinone radicals prepared by pulse radiolytic oxidation of dihydroxybenzoic acids has been examined by time-resolved absorption spectrophotometry. The pK/sub a/ for dissociation of the OH proton in 3-carboxyl-1,4-benzosemiquinone is found to be 6.47 or 2.4 units higher than that in the unsubstituted radical. This pK/sub a/ is, however, well below that of the OH proton in salicyclic acid (13.6) so that hydrogen bonding is appreciably decreased by the delocalization of the unpaired spin in this radical. Protonation of the basic form of the radical occurs at the diffusion-controlled rate. The rate constant for deprotonation by OH^- is relatively low, $4.7 \times 10^7\ M^{-1}\ s^{-1}$, so that reaction with base becomes important only above pH 10. As a result this radical provides an excellent system for studying acid-base equilibration processes in near neutral solutions. Azide ion is shown to be an efficient catalyst which allows the acid-base equilibrium to be examined on the 10-μs time scale. Deprotonation is also catalyzed by the dihydroxybenzoic acid used as the radical source. Analogous studies on 4-carboxy-1,3-benzosemiquinone give the pK/sub a/ as 7.9. In spite of this high pK/sub a/, which indicates the rate constant for spontaneous dissociation of this radical to be $> 10^3\ s^{-1}$, the rate constant for deprotonation by OH^-, $4.9 \times 10^8\ M^{-1}\ s^{-1}$, is considerably higher than in the case of 3-carboxy-1,4-benzosemiquinone.

15503 **Dynamics of geminate ions in the pulse radiolysis of cyclohexane and n-hexane containing aromatic solutes studied by streak camera measurements of fluorescence and absorption.** Sauer, M.C. Jr.; Romero, C.; Schmidt, K.H. (Argonne National Lab., IL, USA). *Radiation Physics and Chemistry, International Journal of Radiation Applications and Instrumentation Part C;* **29**: No. 4, 261-273(1987). Contract W-31-109-ENG-38.

The nature of geminate ion reactions in cyclohexane or n-hexane solutions irradiated with 30 ps electron pulses has been investigated by observing solute excited state fluorescence and absorption of solute ions. For the fluorescence measurements, 4-Br,4"hexa(5-decyl)-p-terphenyl(BHTP) was used as the solute. Comparison of the results with a model indicates a qualitative correspondence with the known properties of ions and electrons in the two solvents. In particular, the results support a higher mobility cation derived from the solvent in cyclohexane, compared with n-hexane. Quantitatively, however, the experimental data show a greater amount of excitation occurring within the first 20 ps (during the pulse) than is expected from the model. Results on the formation of the pyrene radical cation in cyclohexane and n-hexane solutions of pyrene also show significant differences between the two solvents which indicate a slower formation of the pyrene cation in n-hexane.

15504 **ESR/ENDOR study of the guanine cation: Secondary product in 5' -dGMP.** Close, D.M.; Hole, E.O.; Sagstuen, E.; Nelson, W.H. (E.T.S.U., Johnson City, TN). pp 93 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Previous ESR studies by Voit and Huttermann of x-irradiated single crystals of 2' deoxyguanosine-5'-monophosphate have indicated the presence of a radical thought to be formed by deprotonation of the primary base cation at N1. In this study the authors report results of a detailed ESR and ENDOR experiment at 10 K which conflict with the results cited above. One of the radicals detected inhibited two α-proton type couplings. The data analysis shows that one coupling is due to the proton on the extra annular NH/sub 2/ group, while the other is due to the proton bonded to C8.

15505 **Sensitive chemical procedure for monitoring the radiolytic oxidation of proteins at γ-ray dosages down to 1 Krad.** Jayko, M.E.; Garrison, W.M. (Lawrence Berkeley Lab., CA, USA). *Radiation Effects Letters;* 87: No. 6, 299-303(Jun 1986). Contract AC03-76SF00098.

The radiolytic degradation of proteins in oxygenated solution is initiated by the attack of OH radicals at a multiplicity of main-chain and side-chain loci to give a wide variety of oxidized protein sites. A major fraction of these oxidation reactions lead to the introduction of reactive carbonyl groups into the protein covalent structure. With γ-rays the total carbonyl yield correspond to G(>C0)sub(t) approx. 1 for a number of different proteins. Outlined here is a sensitive chemical-spectrophotometric procedure for quantitatively monitoring G(>C0)sub(t) over a dose range of interest in radiation biology (1 to 50 Krad). Data obtained with pepsin, α-chymotrypsin and β-lactoglobulin are discussed.

15506 **Magnetic resonance studies of paramagnetic transients in liquids.** Trifunac, A.D.; Bartels, D.M.; Thurnauer, M.C.; Lawler, R.G. (Argonne National Lab., IL, USA; Brown Univ., Providence, RI, USA. Dept. of Chemistry). *Progress in Reaction Kinetics;* 14: No. 2, 43-156(1986). Contract W-31-109-ENG-38.

The paper reviews the work carried out using time-resolved electron paramagnetic resonance (EPR) and related techniques. The experimental methods used to create and detect free radicals are discussed, including radiolysis. Two radiolytic techniques, i.e. the pulsed electron accelerators and radionuclides, which have been used to produce radicals for EPR detection, are both described.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 14199, 14365, 16144

15507 **(CEA-CONF—9063) 5f and 4f ion complexes with dibutylphosphate ions.** Musikas, C.; Livet, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Apr 1987. 12p. (CONF-870443—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751713/JAW.

From 2. international conference on the basic and applied chemistry of f-transition (lanthanides and actinides) and related elements; Lisbon, Portugal (6 Apr 1987).

This paper is a survey of the literature and it includes recent results obtained in our laboratory concerning the species of actinides and lanthanides formed in aqueous solutions in the presence of DBP/sup -/ ions. The solubility of lanthanides (DBP)/sub 3/, thorium, neptunyl and uranyl ions into aqueous solutions as a function of DBP/sup -/ ion concentration is studied. 8 refs.; 4 figs.; 2 tables.

15508 **(CEA-CONF—9139) Design and development of radiopharmaceuticals based on monoclonal antibodies.** Saccavini, J.C.; Kremer, M. (Compagnie ORIS Industrie, 91 - Gif-sur-Yvette (France)). May 1987. 2p. (CONF-8705177—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751358/JAW.

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

Published in summary form only.

15509 **(DOE/ER/13231—T1) High energy halogen atom reactions activated by nuclear transformations: Technical progress report.** Rack, E.P. (Nebraska Univ., Lincoln (USA)). 1988. Contract FG02-84ER13231. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004247/JAW.

Research and progress are described in the following areas: (1) stereochemistry and mechanisms of halogen atom reactions, (2) application of radioactivity to chemical problems. A method was developed for the determination of trimethylselenonium ion and selenite (SeO_3^{2-}) ion in urine, (3) isomeric transition chemistry, in which a new procedure was developed for the determination of ^{82}Br yields. (CS)

15510 **(DOE/ER/60526—1) A new approach to the analysis of radiopharmaceuticals: Progress report, January 15-November 1, 1987.** Jones, A.G.; Davison, A.; Costello, C.E. (Harvard Medical School, Boston, MA (USA). Dept. of Radiology; Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). 1987. Contract FG02-87ER60526. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003802/JAW.

This research is designed to develop analytical techniques that may be used in the study of both the basic chemistry and the radiopharmaceutical chemistry of the transition metal technetium. The initial proposal involved the applications of high performance liquid chromatography (HPLC) and mass spectrometry (MS) to these topics, and the second phase added the technique of resonance Raman spectroscopy. During the period covered by this report, a number of interesting avenues have been pursued. These include the use of a newly acquired rotating anode x-ray diffractometer and the use of ^{99}Tc NMR spectroscopy to examine a variety of problems. 14 figs., 2 tabs.

15511 **(INIS-mf—10774) Transport behaviour of Pu(III) and neptunium in different oxidation stages in aqueous systems with particular attention to the effect of complex formation.** Feldner, K.H. (Freie Univ. Berlin (Germany, F.R.). Fachbereich Chemie). 11 Jul 1985. 170p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751505/JAW.

The aim of this dissertation is to determine the transport behaviour of selected actinides under the effect of an electrostatic field, on the one hand, and under the influence of a concentration gradient, on the other hand. The dependence of the concentration on conductivity of the Pu(III) ions in hydrochloric acid and the Np(IV) ions in nitric acid was measured and the ion movement for Pu/sup 3+/ and Np(OH)/sup 3+/ was calculated. For the investigation of the transport behaviour of actinides under the effect of a concentration gradient, neptunium was used in its oxidation stages +4, +5 and +6, as they occur in the conditions of the PUREX process, or in 1M HNO/sub 3/. Complex formation was also taken into account which, apart from in the nitric acid, was also examined in hydrochloric and perchloric acid. It has a great effect on the dependence on concentration of the diffusion coefficient which must be taken into account in theories to be worked out for ternary systems.

15512 **(IPEN-Pub—87) Optimization of the basic zirconium sulphate precipitation.** Nakamura, A.T.O.; Bergamashi, V.S.; Sood, S.P. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Jun 1987. 9p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700239/JAW.

Zirconium recovery from hexone-HSCN solvent extraction raffinates through its basic sulphate precipitation has been investigated in the present study. Metal and sulphate ion concentration, initial pH and temperature during precipitation were optimezed studying the sedimentation time and residual zirconium concentration in the filtrate. Metal concentration of about 20 g/L, sulphate to metal ratio of 0,55 to 0,60 and pH close to 1,0 resulted in good quality product for a precipitation temperature of 85°C. For optimum conditions, sedimentation time was small and zirconium overall yield in the range of 95-99%.

15513 **(IPNO-DRE—84-01) Redox and thermodynamic properties of Cm and transcurium elements.** David, F. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1984. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751612/JAW.

The investigation of the main properties of heavy actinides shows, in each case (i.e. metal, entropies of aqueous ions, hydration, redox properties) that such basic properties are related to the characteristic parameters as radius, the number of f electrons, charge, electronic transitions. Therefore, expressions are obtained which make possible calculation of unknown data and predictions of properties. More work has to be done to get more reliable calculations fitting closely to experimental data: entropies, structures of many aqueous ions, ionization potentials and even existence or stability of

some oxidation states need more imaginative works applying original radiochemical methods and correlations through heavy elements. 9 tables, 13 figs.

15514 **(KFK—4084) Evaluation of the urania equation of state based on recent vapour pressure measurements.** Fischer, E.A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Sep 1987. 88p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751527/JAW.

In the past few years, new experimental results on the vapour pressure of UO/sub 2/ up to extremely high temperatures became available. These vapour pressure data, obtained by advanced experimental techniques, are lower than the ones used so far at KfK. It was, therefore, appropriate to carry out a complete new evaluation of the equation of state (EOS) of UO/sub 2/. The Significant Structures Theory by Eyring, which was extended to the case of non-stoichiometric urania, was applied for this work. The extended theory is described in some detail. By a suitable choice of the model parameters, good agreement of the evaluated EOS with recent experimental data was obtained, which is additional evidence for the reliability and consistency of the recent data. The extrapolation predicts a critical temperature of 10600 K, which is higher than earlier predictions. Analytical fits for the important state variables were produced for convenient use in fast reactor accident analysis codes.

15515 **Synthesis and evaluation of fluorinated derivatives of fentanyl as candidates for opiate receptor studies using positron emission tomography.** Dahren Hwang; Feliu, A.L.; Wolf, A.P.; MacGregor, R.R.; Fowler, J.S.; Arnett, C.D. (Brookhaven National Lab., Upton, NY, USA). *Journal of Labelled Compounds and Radiopharmaceuticals;* 23: No. 3, 277-293(Mar 1986). Contract AC02-76CH00016.

Three fluorinated derivatives of fentanyl, fluorofentanyl (3), keto-fluorofentanyl (5), and fluorofentanol (6), were synthesized and their abilities to compete with ^{3}diprenorphine for binding sites in guinea pig brain membranes were determined. The relative potencies were fentanyl > 3 approx.$= 6 >> 5$. On the basis of its apparent affinity for opiate receptors and its relative ease of synthesis, 6 was selected for further study. Fentanyl was slightly better than 6 in its ability to compete with [^{3}H]naltrexone for binding sites in rat brain membranes. Both fentayl and 6 exhibited a similar high "sodium ratio" (quotient of the IC_{50}'s against [^{3}H]naltrexone in the presence and absence of sodium chloride) generally characteristic of opiate agonists. The analgesic potencies of fentanyl and 6 were determined in rats by measuring suppression of locomotion and vocalization responses to footshock. 6 appeared slightly less potent than fentanyl, but produced a similar analgesia and catalepsy which was entirely blocked by pretreatment of rats with naloxone, an opiate antagonist. A rapid synthesis of [^{18}F]-6 was developed and the tissue distribution of [^{18}F]-6 in mice was determined 5, 60, and 120 minutes after intravenous injection. The use of this general route to ^{18}F-labeled derivatives of fentanyl for studies of the opiate receptor using positron emission tomography is planned.

15516 **Stereospecific approach to the synthesis of [^{18}F]2-deoxy-2-fluoro-D-mannose.** Luxen, A.; Satyamurthy, N.; Bida, G.T.; Barrio, J.R. (California Univ., Los Angeles, USA. Dept. of Radiological Sciences; California Univ., Los Angeles, USA. School of Medicine; California Univ., Los Angeles, USA. Lab. of Nuclear Medicine and Radiation Biology). *Applied Radiation and Isotopes;* 37: No. 5, 409-413(1986). Contract AC03-76SF00012.

The reaction of methyl 4,6-O-benzylidene-3-O-benzyl-2-O-trifluoromethanesulfonyl-β-D-glucopyranoside in acetonitrile at 75°C for 30 min with [^{18}F]tetra-n-butylammonium fluoride, followed by silica gel column chromatographic purification, gave the corresponding [^{18}F]methyl 4,6-O-benzylidene-3-O-benzyl-2-fluoro-β-D-mannopyranoside with complete regio- and stereoselectivity (42% radiochemical yield). Hydrolysis of the radiolabeled fluoromannopyranoside intermediate with either 6N HCl or 50% methanesulfonic acid for 30 min at 120°C, followed by purification by column chromatography (ion retardation resin and neutral alumina), gave pure [^{18}F]2-deoxy-2-fluoro-D-mannose ([^{18}F]2-FDM) with an overall radiochemical yield (from [^{18}F]fluoride ion) of 34%. Extension of this methodology to the no carrier added (nca) synthesis under phase transfer conditions (Kryptofix 222/K ^{18}F/acetonitrile) gave nca [^{18}F]2-FDM in a radiochemical yield of 75%. Purity and identity of the fluorinated products were confirmed by ^{1}H and ^{19}F NMR spectroscopy. The synthetic procedure described here permits for the first time the routine preparation of large amounts of [^{18}F]2-FDM for tomographic studies.

15517 **2-deoxy-2-[^{18}F]fluoro-D-glucose for metabolic studies: current status.** Fowler, J.S.; Wolf, A.P. (Brookhaven National Lab., Upton, NY, USA). *Applied Radiation and Isotopes;* 37: No. 8, 663-668(1986).

This paper provides a historical perspective and update of the methods of preparation and properties at 2-deoxy-^{18}F-fluoro-d-glucose (^{18}FDG) and discusses some current applications in the biomedical sciences, particularly its use in positron computed tomography, and possible future applications are discussed. (U.K.).

15518 **Radiobrominated spiroperidol for the study of dopamine D2 receptors.** De Jesus, O.T.; Friedman, A.M. (Chicago Univ., IL, USA. Dept. of Radiology; Chicago Univ., IL, USA. Dept. of Radiology; Argonne National Lab., IL, USA). *Applied Radiation and Isotopes;* 37: No. 8, 719-726(1986).

Some neuropsychiatric disorders have been suggested to be related to the CNS dopaminergic system. In order to probe this neurotransmitter system, radiobrominated spiroperidol, a potent dopamine (DA) D2-receptor antagonist, was developed. This review deals with the routine synthesis of [sup(75,76, or 77)Br]-p-bromospiroperidol (BrSP), its validation as a radiopharmaceutical directed to DA D2 receptors, and the imaging studies which have been done using this radioligand with either single photon tomography (SPECT) or positron tomography (PET). [*Br]BrSP will be compared to other D2 ligands currently available. The present state and future direction of DA receptor research, in particular, the quantitative aspects, will be discussed.

15519 **Organoastatine chemistry. Astatination via electrophilic destannylation.** Milius, R.A.; McLaughlin, W.H.; Bloomer, W.D.; Lambrecht, R.M.; Wolf, A.P.; Carroll, J.J.; Adelstein, S.J. (Harvard Medical School, Boston, MA, USA; Mount Sinai Medical Center, New York, US. Dept. of Radiotherapy; Mount Sinai Medical Center, New York, US. Dept. of Radiotherapy; Brookhaven National Lab., Upton, NY, USA; Harvard Medical School, Boston, MA, USA). *Applied Radiation and Isotopes;* 37: No. 8, 799-802(1986).

Substantial interest is currently focused on the α-emitting radiohalogen ^{211}At, principally because of its potential use in the radiation therapy of cancer. Knowledge of organoastatine chemistry is incomplete and existing methods for its incorporation restrict the range of compound which may be labeled. Aryl and vinyl Sn(IV) compounds are notably susceptible to substitution of tin by a variety of electrophiles. We have investigated the reaction of aryltrialkylstannanes with astatine and report here the first examples of astatodestannylation. Formation of aryl astatides proceeds rapidly, cleanly and under mild conditions. The data further elucidate aspects of astatine reactivity and suggest a general route to synthesize astatinated compounds.

15520 **Cyclotron production of ^{123}Xe(20.1 h) → ^{123}I (β + 77%; EC 23%; 3.6 min) for positron emission tomography. Current methods and potential developments.** Lagunas-Solar, M.C.; Carvacho, O.F.; Harris, L.J.; Mathis, C.A. (California Univ., Davis, USA. Crocker Nuclear Lab.; Lawrence Berkeley Lab., CA, USA). *Applied Radiation and Isotopes;* 37: No. 8, 835-842(1986).

Iodine-122 (3.6 min; β + 77%; EC 23%) is a positron-emitting radionuclide (PER) which can be used in the synthesis of PET radiopharmaceuticals. Its production and availability from a ^{123}Xe(20.1 h)→^{123}I(3.6 min) parent/daughter transportable-generator system are discussed. Several hundred millicuries of the parent ^{123}Xe can be produced directly from a ^{127}I target via the

$^{127}I(p,6n)^{123}Xe(Q= -45.50$ MeV), using targetry and remote-handling techniques similar to the large-scale production of ^{123}I. With proper design of remote-handling systems, a single $^{123}Xe \rightarrow ^{123}I$ generator can provide, in rapid succession (i.e. 20-30 min), several tens-millicurie batches of ^{123}I for syntheses purposes. The 3.6-min half life of ^{123}I also offers the potential for sequential use of ^{123}I radiopharmaceuticals in PET studies. Other methods with potential for large-scale production of ^{123}Xe are also discussed.

15521 Modular automation in PET tracer manufacturing: application of an autosynthesizer to the production of 2-deoxy-2-[^{18}F] fluoro-D-glucose. Alexoff, D.L.; Russell, J.A.G.; Shiue, C.Y.; Wolf, A.P.; Fowler, J.S.; MacGregor, R.R. (Brookhaven National Lab., Upton, NY, USA). *Applied Radiation and Isotopes;* 37: No. 10, 1045-1061(1986). Contract AC02-76CH00016.

A compact autosynthesizer was developed and used successfully for the production of 2-deoxy-2-[^{18}F]fluoro-D-glucose [^{18}FDG] from gaseous acetyl hypo[^{18}F]fluorite. The autosynthesizer performs a sequence of general purpose synthesis procedures named Synthesis Unit Operations (SUOs). Each SUO is controlled through execution of a digital control algorithm with a BASIC language subroutine. This automatic synthesis system is based on two industry standard microcomputer architectures, the IBM PC and STD Bus, and it becomes a component of an evolving distributed microprocessor network of task-dedicated subsystems suitable for automated manufacturing of several useful radiotracers. The yield of ^{18}FDG product using the autosynthesizer and remote manually controlled purification procedures is approx. 20% EOB. Radiochemical purity of this product as measured by thin layer chromatography was 96-99%. Chemical purity of the product was measured to be approx. 96%. 2-Deoxy-2-fluoro-D-mannose impurity from this method was determined to be approx. 4%.

15522 Automated high pressure reaction vessel for routine preparation of short-lived radiopharmaceuticals. Ropchan, J.R.; Ricci, A.R.; Low, G.C.; Phelps, M.E.; Barrio, J.R. (California Univ., Los Angeles, USA. School of Medicine; California Univ., Los Angeles, USA. Lab. of Nuclear Medicine and Radiation Biology). *Applied Radiation and Isotopes;* 37: No. 10, 1063-1068(1986). Contract AC03-76SF00012.

A remote, automated high-pressure/temperature system for preparation of radiopharmaceuticals is described. The system was routinely employed in our laboratories in the production of multi-millicurie amounts of ^{11}C labeled D,L-amino acids in more than 90 production runs, with typical final D,L-product activities of 240-400 mCi. The high pressure system, however, is not restricted only to the production of ^{11}C labeled amino acids, but for application in any synthetic procedure requiring high pressure (approx. 300 psia) and temperature (>300°C).

15523 Extraction of ^{153}Gd from HFIR control plates. Kohring, M.W. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* 52: 348-349(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The primary method of ^{153}Gd production at the Oak Ridge National Lab. (ORNL) research reactors since 1980 has been the irradiation of a natural europium oxide powder (Eu_2O_3) followed by the chemical extraction of the gadolinium fraction. The specific activity of the resulting source is 45 to 50 Ci/g with a radiochemical purity of > 99.99%. A potential alternative method involves the extraction of gadolinium from the europium-bearing region of highly radioactive, spent control plates used in the High Flux Isotope Reactor (HFIR), followed by neutron irradiation. This alternative to the traditional process is attractive in that chemical separation of the europium and gadolinium occurs before the ^{153}Gd production irradiation, thus reducing process and decay losses and, most significantly, the gadolinium is highly enriched in the parent isotope, ^{152}Gd. Investigation into the usefulness of the gadolinium isotopes contained in spent HFIR control plates began in the late 1960s. However, separation of the gadolinium from the europium to the purity levels required for a marketable specific activity could not be attained. Due to the recent increase in ^{153}Gd demand and separation process improvements, research into this valuable source of parent material was resurrected.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 15426, 15686, 15687

15524 (DOE/ER/10909—T1) Combustion Research Program: Flame studies, laser diagnostics, and chemical kinetics: Final report. Crosley, D.R. (SRI International, Menlo Park, CA (USA)). Nov 1986. Contract AC02-81ER10909. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004206/JAW.

During the past five years under Department of Energy support, the overall question of providing a fundamentally sound and experimentally verifiable description of combustion chemistry through three separate but closely related efforts has been addressed: the study of the laser-induced fluorescence (LIF) spectroscopy of key reaction intermediates; the estimation of rate constants and formulation of chemical kinetic models; and the development of a new kinetic tool, laser pyrolysis/laser fluorescence (LP/LF) for the dual purposes of measuring reaction rates at elevated temperatures and producing limited chemical networks to test the models. Tets of the LP/LF method to date have involved reactions of OH with these hydrocarbons. An LP/LF study of the NH_2 + NO reaction has just been initiated.

15525 (DOE/ER/13508—2) [The detection of the ethynyl radical for studies of the chemistry of soot formation in hydrocarbon combustion]. (Cornell Univ., Ithaca, NY (USA). School of Applied and Engineering Physics). [1988]. Contract FG02-86ER13508. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005457/JAW.

The first observations were made of a new state of the C_2 radical via (2 + 2) resonance-enhanced multiple-photon ionization spectroscopy. The first laser-based observations of the HCO radical in a flame environment are reported. 27 refs., 12 figs. (DLC)

15526 (SRD-R—372) Description of the two-dimensional combustion code FLARE. Martin, D. (UKAEA Safety and Reliability Directorate, Culcheth). Jul 1986. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750926/JAW.

This report gives details of the computer code FLARE. The model used for the turbulent combustion of premixed gases is described. Details of the numerical scheme used to solve the resulting equations are discussed. The input and output for the code are also described. Details of the coding are given in the Appendices together with sample input and output.

15527 (SRD-R—373) Some calculations using the two-dimensional turbulent combustion code flare. Martin, D. (UKAEA Safety and Reliability Directorate, Culcheth). Sep 1986. 40p. H.M. Stationery Office, London, price Pound 4.00.

A brief description of the code FLARE is given. Both the model used in FLARE and the numerical scheme used to implement the model are described. Results for the simulation of an experiment are presented and discussed. An alternative turbulence model to that used in FLARE is discussed but it is concluded that the original model is better.

15528 Powder aspirator for shock tube studies of heterogeneous reactions. Cheng, M.T.; Kirsch, M.J.; Lester, T.W. (Department of Mechanical Engineering, Louisiana State University, Baton Rouge, Louisiana 70803). *Review of Scientific Instruments;* 59: No. 2, 322-327(Feb 1988).

The application of single-pulse shock tube techniques in the study of heterogeneous reactions is described. In particular, nitric oxide removal on carbonaceous materials at temperatures simulating pulverized coal firing is reported. Carbon black particulates were suspended and heated behind reflected shock waves in order to simulate flame-borne particulates. To meet the specific require-

ment of preshock conditions, a novel and simple powder aspirator was designed and fabricated for dispersing carbon black. Particle concentrations measured by a gravimetric method and by in-line light transmission were compared. Changes of nitric oxide concentration, reaction products and volatile species emitted from the particulates were analyzed with gas chromatographic techniques. Representative results of nitric oxide reduction by carbon black particulates at concentrations up to 50 g/m^3 are provided, and indicate that single-pulse shock tubes coupled with a simple powder aspirator may be used to infer global rates for gas/solid reactions of potential importance in combustion.

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15529 (RFP—4183) Measurements as a process. Ferris, Y.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 18 Nov 1987. Contract AC04-76DP03533. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005275/JAW.

The author defines measurement as a process analogous to any manufacturing or fabrication activity. Those aspects of measurement which support this view are outlined. These include design of the measurement process to meet user requirements, training to perform the measurement process, quality assurance considerations, and documentation and procedures capable of being scrutinized by auditors.

15530 (UCID—20366-88) Engineering thrust areas, 1988. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005103/JAW.

This volume is a compilation of major research areas of the Engineering Research Program at Lawrence Livermore Laboratory. Topics included are: (1) computer studies of electromagnetic problems, (2) application of the finite element method to mechanical engineering, (3) microelectronics, (4) fabrication technology, (5) pulsed power equipment, (6) nondestructive testing, and (7) remote sensing. (BCS)

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REFER ALSO TO CITATION(S) 14007, 14008, 14010, 14011, 14174, 14184, 14325, 14325, 14503, 14708, 14796, 14864, 15080, 15088, 15662, 15679, 15731, 15778, 15779, 15795, 15914, 17341

15531 (AD-A—185682/2/XAB) Superconducting switch program. Interim report, September 1985-September 1986. Francavillia, T.L.; Wolf, S.A.; Gubser, D.U. (Naval Research Lab., Washington, DC (USA)). 30 Sep 1987. 19p. (NRL-MR—5997). NTIS, PC A03/MF A01.

The NRL Superconducting Opening switch program for 1985 to 1986 is reviewed. The results of material studies to determine sputtering parameters is presented along with preliminary switching studies to determine switching speed. The investigation is continuing.

15532 (AD-A—185736/6/XAB) Manned integrity testing of the US Coast Guard chemical-response suit. Final report, January 1985-September 1987. Johnson, J.S. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. 58p. NTIS, PC A04/MF A01.

This report describes manned integrity testing of the U.S. Coast Guard's Chemical Response Suit designed for hazardous-chemical-spill response. Lawrence Livermore National Laboratory developed a test protocol for measuring the dynamic integrity of totally encapsulating chemical-protective suits. This protocol involves the use of both Freon and aerosol challenge agents for measuring suit intrusion coefficients during an exercise routine. In the test, a subject wearing the encapsulating suit and a self-contained breathing apparatus, exercises for 30 minutes while the internal and chamber concentrations of the challenge agents are measured. Intrusion coefficients are measured by ratioing the concentrations of the challenge agent inside and outside the suit. Also pressure inside the suit is measured during the test. Lawrence Livermore National Laboratory tested the integrity of several Coast Guard Chemical Response Suits. Intrusion coefficients ranging over 10,000 and internal suit pressures from 0.1 to 7.0 inches water pressure (gauge) were observed. This testing was useful in identifying design problems for early prototypes of the Chemical Response Suit.

15533 (AD-A—185740/8/XAB) Use of alloy 117 as a liquid-metal current collector. Research and development report, January-March 1986. Maribo, D.; Sondergaard, N. (David W. Taylor Naval Ship Research and Development Center, Annapolis, MD (USA). Propulsion and Auxiliary Systems Dept.). Sep 1987. 19p. (DTNSRDC-PAS—87-06). NTIS, PC A03/MF A01.

Low-melting-point, bismuth-based alloys are potential replacements for NaK78 as liquid-metal slip-ring material because of their lower reactivity and potentially greater hydrodynamic stability. This paper describes experiments with one such alloy in a model of a 300-kW superconducting homopolar motor using close-clearance braid-type collectors. Slip-ring tip velocities varied from 5 to 20 m/s and currents ranging from 500 to 2000 A. Viscous power losses tend to follow a simple turbulent mode. In all, the data support the use of low-melting-point alloys as an alternative to Na78.

15534 (AEEW-M—2273) Interface between I-DEAS and DYNA3D. Andress, J.C. (UKAEA Atomic Energy Establishment, Winfrith). Jan 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750857/JAW.

The I-DEAS software package can be used interactively to generate 3-dimensional finite element models for subsequent analysis. This memorandum describes techniques which allow I-DEAS to be used for the generation of finite element models for the code DYNA3D which is being used at Winfrith for impact analysis. In particular, it is shown how impacting and sliding interfaces can be defined conveniently even though the I-DEAS software does not directly support this feature of the DYNA3D code. A simple example is included to illustrate the use of the techniques described in this memorandum.

15535 (AEEW-M—2321) Consideration of some simple models for assessing heat transfer to objects engulfed in pool fires. Fry, C.J. (UKAEA Atomic Energy Establishment, Winfrith). Mar 1985. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750859/JAW.

Two simple models for assessing the heat flux into objects engulfed in pool fires are considered. The two models differ in that the first models radiation from the fire as coming from a solid black surface surrounding the object while the second represents the flames as a uniform medium of finite thickness. The readings from thermocouples measuring flame temperature is considered using the two models and it is shown that the measured temperature may differ significantly from the true flame temperature. A simple design of instrument for measuring the effective black body radiation temperature is discussed.

15536 (AEEW-R—1918) FLUFF code for calculating finned surface heat transfer - description and user's guide. Fry, C.J. (UKAEA Atomic Energy Establishment, Winfrith). Aug 1985. 57p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750860/JAW.

FLUFF is a computer code for calculating heat transfer from finned surfaces by convection and radiation. It can also represent heat transfer by radiation to a partially emitting and absorbing medium within the fin cavity. The FLUFF code is useful not only for studying the behaviour of finned surfaces but also for deriving heat fluxes which can be applied as boundary conditions to other heat transfer codes. In this way models of bodies with finned surfaces may be greatly simplified since the fins need not be explicitly represented.

15537 (AEEW-R—1971) Radiological evaluation of the BNFL Purged Posting Port under highly active alpha conditions. Peake, L.J. (UKAEA Atomic Energy Establishment, Winfrith). Aug 1985. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750957/JAW.

The Posting Port uses a gas purge to sweep the exposed seals and to minimize any particulate deposition. The efficiency de-

pends on the velocity and distribution of the gas. A total of 5000 simulated posting movements was performed and the resulting airborne and surface activity monitored. Results are given. The unit proved reliable and easy to operate, and would with a routine monitoring procedure, provide a viable alternative to existing methods of bag posting. (U.K.).

15538 **(AERE-R—12323) Collection of aerosols in HEPA filters.** Pratt, R.P.; Stewart, B.L. (UKAEA Atomic Energy Research Establishment, Harwell. Engineering Projects Div.). Sep 1986. 14p. H.M. Stationery Office, London, price Pound 4.00.

The performance of HEPA filters of both minipleat and conventional deep pleat designs has been assessed at Harwell Laboratory (UKAEA). Results are presented on routine dust loading versus pressure drop characteristics for both designs of filters, using a range of test dusts. Investigations into media arrangements effects for sub micron aerosols, were also carried out. The effects of geometric arrangement of filter media within the filter frame was studied by Loughborough University on behalf of Harwell Laboratory. The conclusions of this study are included in the present paper.

15539 **(AWRE—44-99-3) Selection of portable tools for use in a size reduction facility.** Hawley, L.N. (Ministry of Defence, Aldermaston (UK). Atomic Weapons Research Establishment). Jul 1986. 15p. (PCMRP—85-P3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750843/JAW.

A range of portable tools are identified for development and eventual use within a remote operations facility for the size reduction of plutonium contaminated materials. The process of selection defines the work to be performed within the facility and matches this to the general categories of suitable tools. Specific commercial tools are then selected or, where none exists, proposals are made for the development of special tools.

15540 **(BNL—40533) UHV [ultra-high vacuum] double crystal monochromator design.** Morrison, T.I.; Lien, N.C.; Heald, S.M.; Fareria, L.S.; Scrofani, J. (Illinois Inst. of Tech., Chicago (USA). Dept. of Physics; Baker Mfg. Co., Evansville, WI (USA); Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 12p. (CONF-870610—19). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003904/JAW.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

An ultra-high vacuum double-crystal fixed-exit x-ray monochromator has been designed and built for soft X-ray (0.8-8 KeV) spectroscopic studies. This unit, currently installed at the NSLS on beamline X-11B, uses two crystal carousels, each of which can hold four different crystals to allow crystal changes without opening the chamber. The incident crystal carousel, which only rotates, is water cooled to remove the incident beam heat load. The second carousel, which rotates and translates parallel to the beam axis, can be heated to equilibrate crystal temperatures. Design principles and results of preliminary tests are presented. 5 refs., 4 figs.

15541 **(CEA-CONF—9053) Laser robot in the nuclear industry.** Contre, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). May 1987. 31p. (In French). (CONF-8705130—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751840/JAW.

From International conference on laser advanced materials processing: science and applications; Osaka, Japan (21 May 1987).

Possibilities of power lasers for welding, cutting, drilling, plugging surface treatment and hard-facing are reviewed. CO/sub 2/ and Nd:YAG lasers only have adequate power for nuclear applications. Radiation effects on lasers and contamination problems are examined. Then examples of applications to nuclear industry are given: PWR fuel fabrication, oxide thickness measurement in Magnox reactors, laser cutting of a cylindrical piece of steel on the bottom of a fuel channel in a gas graphite reactor, nuclear plant dismantling and fuel reprocessing. 51 refs.

15542 **(CEA-CONF—9148) Mechanical Behaviour of the asbestos-cement container for geological disposal of α level technological wastes from Cogema reprocessing plants.** Francois, Y.; Dourthe, M.; Jaouen, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Mar 1987. 8p. (CEA-DAS—342; CONF-870306—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751566/JAW.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

For the safety assessment of the SGN asbestos cement container concept selected by COGEMA for the conditionning of cemented α technological wastes from the UP3-UP2 800 reprocessing plants, a general survey has been carried out to confirm both its confinement capacity and its mechanical strength. This safety assessment relates to the latter aspect. It implies two stages: first, the material characterization of asbestos cement and epoxide resin used in sealing and assembling; second, the finite element calculation of induced stresses and strains under storage conditions with regards to the experimented mechanical characteristics. We infer some damage in packaging materials in case of misoperation in conditionning process.

15543 **(DOE/CH/46656—06) Waste hoist technology.** (Morrison-Knudsen Engineers, Inc., San Francisco, CA (USA); Fluor Technology, Inc., Irvine, CA (USA)). Sep 1987. Contract AC02-83WM46656;AC02-87CH10290;AC02-83CH10140. 119p. NTIS, PC A06. Order Number DE88002493/JAW.

This report evaluates unique applications of current hoisting design practice that satisfy the waste package transfer functional requirements for a Nuclear Waste Repository in Salt. Hoisting system configurations that could provide the desired service for this important function are identified. Implications on hoist design for both shielded and unshielded waste package casks are evaluated. The report also presents specially engineered features which limit exposure levels to as low as is reasonably achievable (ALARA) criteria. 32 refs., 7 figs., 7 tabs.

15544 **(DOE/ER/45258—T2) A modified version of the phase sensitive technique for measurements of absolute sound velocity in solids.** Toulouse, J. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Physics). 1987. Contract FG02-86ER45258. 4p. NTIS, PC A02. Order Number DE88002303/JAW.

Measurements of absolute sound velocity in solids can be performed automatically by the phase sensitive technique. This technique is based on the relationship between frequency changes and known phase shifts. Frequency changes, however, also result in unknown phase shifts due to reflections at the transducer-bond interface, and to dispersion in the sample. To avoid this problem, we have devised a modified version of the technique which is described here. We also report results of absolute velocity measurements using the new version and compare them with similar measurements obtained with the old one.

15545 **(DOE/ID/12566—T1) Assessment of strength limiting flaws in ceramic heat exchanger components: Phase 1, Final report, September 28, 1984-June 30, 1986.** Powers, T.; Snyder, J. (Babcock and Wilcox Co., Lynchburg, VA (USA). Lynchburg Research Center). Oct 1986. Contract AC07-84ID12566. 165p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88004025/JAW.

Assurance of energy efficient design lifetimes of high temperature structural ceramics requires the ability to specify acceptance criteria and to test to those criteria. These criteria will be established through nondestructive testing, to determine which defects are detectable, together with fracture mechanics, to calculate effects of indetectable flaws. The first phase of this program is to examine heat exchanger material with four test methods which have shown promise for use in ceramics; ultrasonic scanning, microfocus x-ray, Scanning Laser Acoustic Microscope, and Acoustic Holography. The capabilities, limits, and potential for improvement of these are presented in this report. Destructive testing, material sectioning, and fractography are included. 24 refs., 68 figs., 6 tabs.

15546 **(ENEA-RT-FUS—87-12) Superconductivity above 90K in the Y-Ba-Cu-O compound system.** Paterno, G.; Balestrino, G.; Barbanera, S. (ENEA, Frascati (Italy). Centro Ricerche Energia). 1987. 8p. (CONF-8704190—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701270/JAW.

From 7. general conference of the condensed matter; Pisa, Italy (7 Apr 1987).

Preliminary results on high Tc superconductors are reported. One of Y-Ba-Cu-O compound system has been fabricated. The temperature dependence of the resistance has been determined. The critical temperature of the samples annealed in Oxygen atmosphere is well above the normal boiling point of liquid nitrogen.

15547 **(IFVE-OUNK—85-161) Apparatus to measure dependences of critical current in high-current superconductors on temperature and magnetic field.** Melishek, T.; Shirshov, L.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700200/JAW.

Submitted to the journal Instrum. Exp. Tech. .

The apparatus and method to measure the characteristics of superconductor short samples in the temperature range 2.3-9 K and the magnetic field up to 6 T at the transport current up to 10 kA are described. 10 references, 2 figures.

15548 (INIS-BR—748, pp 94) **Measurement systems for ultralow temperatures in the presence of magnetic fields.** Bindilatti, V.; Oliveira Junior, N.F.; Puech, L. (Sao Paulo Univ., Brazil; Centre National de la Recherche Scientifique, 38 - Grenoble, France). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15549 (INIS-BR—748, pp 94) **Cryostat in stainless steel for EPR in temperature range from 1,5 to 4,2 K.** (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15550 (INIS-BR—748, pp 94) **Superconducting magnets for low helium consumption systems.** Vellego, G.; Otubo, J.; Oliveira Junior, N.F.; Bindilatti, V. (Pirelli S.A.; Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15551 **(INIS-SU—426) A method of calculating nonstationary heat flow in hydrogasodynamic processes in closed cryogenic systems.** Zhitomirskij, I.S.; Romanenko, V.G. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1986. 53p. (In Russian). (PREPRINT—32-86). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700884/JAW.

A cryogenic system is considered comprising a number of liquid cryogen vessels provided with heat insulation including vacuum gaps and radiation shields. A high-versatility program in the PL/1 language is made up which makes it possible to compute the non-stationary temperature fields, pressure fields in the cryogen flow and cryogen distribution over the system channels. An example of computation is given and its results are compared with the experimental data. 35 refs.; 10 figs.; 3 tabs.

15552 **(IVO-B—05/87) Mechanical vibrations caused by wind - chimneys and ventilating pipes.** Lampio, E. (Imatran Voima Oy, Helsinki (Finland)). 1987. 31p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751181/JAW.

The mechanical vibrations of power transmission lines caused by wind have been much studied. This paper applies the results of these studies to the mechanical vibrations of homogeneous vertical and round structures having the same diameter from one end to the other in cases where the lower end of the vibrating structure is rigidly fastened to its base. This report will show that metallic structures having low loss factors - for example, steel-structured chimneys as such - vibrate nearly always at their highest possible amplitude. Concrete chimneys, whose internal damping is from 10 to 20 times the damping of steel chimneys, vibrate at insignificant amplitudes. Generally speaking, vertical chimneys vibrate either at maximum amplitudes or - with sufficient damping - at insignificant amplitudes. The best damping method of the mechanical vibrations of chimneys is a spiral known as Scruton, which effectively prevents the wind energy from giving vibration energy to a structure susceptible to vibration. The locatin of mechanical vibration dampers into a chimney generates e.g. difficult location problems.

15553 **(JAERI-M—87-156) Investigation on structural analysis computer program of spent nuclear fuel shipping cask.** Yagawa, Ganki; Ikushima, Takeshi. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 319p. (In Japanese). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751985/JAW.

This report describes the results done by the Sub-Committee of Research Cooperation Committee (RC-62) of the Japan Society of Mechanical Engineers under the trust of the Japan Atomic Energy Research Institute. The principal fulfilments and accomplishments are summarized as follows: (1) Regarding the survey of structural analysis methods of spent fuel shipping cask, several documents, which explain the features and applications of the exclusive computer programs for impact analysis on the basis of 2 or 3 dimensional finite element or difference methods such as HONDO, STEALTH and DYNA-3D, were reviewed. (2) In comparative evaluation of the existing computer programs, the common benchmark test problems for 9 m vertical drop impact of the axisymmetric lead cylinder with and without stainless steel clads were adopted where the calculational evaluations for taking into account the strain rate effect were carried out. (3) Evaluation of impact analysis algorithm of computer programs were conducted and the requirements for computer programs to be developed in future and an index for further studies have been clarified.

15554 **(K/D—5734) Resolution of numerical control machine tool modification problems using a symbiosis of machinery diagnostics, modal analysis, structural dynamics modification and acoustic intensity analysis.** Van Hoy, B.W.; Strunk, W.D.; Morton, T.L.; Tuft, R.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA); Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OT21400. 15p. (CONF-880220—14). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004794/JAW.

From 6. international modal analysis conference; Orlando, FL, USA (1 Feb 1988).

A multi-million dollar retrofit project was initiated to update a number of older numerical control machine tools. The retrofit replaced the servo control systems, the indexing motors, drive systems and spindle motor. One machine was upgraded as a prototype, but several dynamic problems in both the indexing systems and spindle drive became apparent. These dynamic problems were unacceptable in their effect on machining accuracy. Acoustic intensity measurements were used to pinpoint the source of an irritating 3 KHz tone. This tone indicated a significant amount of energy resulting in a high displacement in the indexing motors. Frequency response measurements of the motor response vs the power supply input quantified the motor problem and the acoustic levels. Modal analysis was applied to the axial resonances of the index motors to determine the response of the mechanical coupling and run up/down tests were used to determine the spindle motor drive problems. 8 figs.

15555 **(K/D—5735) Considerations for the establishment of a machinery monitoring analysis program for surface ships of the US Navy.** Strunk, W.D. (Oak Ridge National Lab., TN (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1987. Contract AC05-84OT21400;AC05-84OR21400. 11p. (CONF-880220—10). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004485/JAW.

From 6. international modal analysis conference; Orlando, FL, USA (1 Feb 1988).

Personnel at the Oak Ridge National Laboratory were tasked by the US Navy to assist in establishing a maintenance monitoring program for machinery aboard surface ships. Given the number of surface ships, the variety of locations in which they operate, the different types of equipment (rotating and reciprocating, as well as instrumentation), and the different procedures which control the operation and maintenance of a ship, it can be seen, apart from the logistics of organizing such a monitoring program, that the technical issues are as varied and numerous as the ships themselves. Unique methods and procedures have been developed to perform the tasks required on a large scale. Among the specific tasks and technical issues addressed were the development and installation of a data collection and communication instrumentation system for each port, the qualification of measurement methodologies and techniques, the establishment of computer data bases, the evaluation of the instrumentation used, training of civilian and military personnel, development of machinery condition assessment aids using machine design and modal analysis information, and development of computer displays. After these tasks were completed and the appropriate resolution integrated into the program, the final task was the development of a method to continually evaluate the effectiveness of the program, using actual maintenance records.

15556 **(K/D—5739) Ultra-low frequency vibration data acquisition concerns in operating flight simulators.** Van Hoy, B.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA); Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OT21400. 20p. (CONF-880220—13). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004795/JAW.

From 6. international modal analysis conference; Orlando, FL, USA (1 Feb 1988).

The measurement of ultra-low frequency vibration (.01 to 1.0 Hz) in motion based flight simulators was undertaken to quantify the energy and frequencies of motion present during operation. Methods of measurement, the selection of transducers, recorders, and analyzers and the development of a test plan, as well as types of analysis are discussed. Analysis of the data using a high-speed minicomputer and a comparison of the computer analysis with standard FFT analysis are also discussed. Measurement of simulator motion with the pilot included as part of the control dynamics had not been done up to this time. The data are being used to evaluate the effect of low frequency energy on the vestibular system of the air crew, and the incidence of simulator induced sickness. 11 figs.

15557 **(LA—11100-MS) Industrial Hygiene Group: 1986 Annual report on research and special activities.** Ettinger, H.J. (ed.). (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005113/JAW.

This report details all the 1986 research activities and some selected operational programs of the Industrial Hygiene Group. During 1986, research studies were directed at: respiratory protection, personal protective clothing, applied industrial hygiene, and aerosols and air cleaning. In several instances, the transfer of technology, previously developed by the Industrial Hygiene Group, is described together with the application of research developments to operational health protection programs.

15558 **(LBL—23304) Wide band data transmission system using optical fibers.** Leskovar, B.; Nakamura, M.; Turko, B.T. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098;W-7405-ENG-48. 10p. (CONF-871006—32). NTIS, PC A02. Order Number DE88004555/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

An ultra high speed data transmission system using optical fibers and gallium arsenide digital integrated circuits has been investigated. The system is designed to meet the increased data rate requirements of modern information processing systems as well as those of future imaging devices and high spatial resolution detectors. A description of the system which uses available components made for the transmission and reception of data at 780 Mbit/s rates is given. Methods for digitizing, multiplexing, demultiplexing, error checking, etc., are also described, and a discussion of the reliability of components is presented. 15 refs.; 9 figs.

15559 **(MLM—3464) Technology Update-87.** (Monsanto Research Corp., Miamisburg, OH (USA). Mound). Dec 1987. Contract AC04-76DP00053. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003974/JAW.

The five papers in this issue of Technology Update reflect improvements in equipment reliability, inspection techniques, data storage techniques, and production technology - all aimed at reducing process variations. Each paper represents an achievement by our technical staff that allows Mound to make more effective use of our resources. A separate abstract has been prepared for one of the papers.

15560 (MLM—3464, pp 14-17) **Evaluating gas transfer pumps for hazardous service.** Strong, J.L. Dec 1987. NTIS, PC A03/MF A01. Order Number DE88003974/JAW.

In Technology Update-87.

A test apparatus with the capability to simulate pump operating conditions has been developed and fabricated. The fully operational test station is used to evaluate the performance of all Mound-fabricated gas transfer pumps prior to their use in hazardous gas-handling service, particularly in handling of tritium. The primary function of the test station is to evaluate the ability of a test pump to generate vacuum while working against head pressure. A secondary function is to test the gas throughput capabilities of a pump when head pressures are held relatively constant. The test station consists of a roughing pump, helium working fluid, transfer cylinders, volumetric flow meter, discharge tank, temperature readout, current and voltage readout, and a data acquisition system. Helium was selected as the working fluid because it closely duplicates the fluid characteristics of tritium and is nonradioactive. The testing of pumping systems, matching of pumps with drive systems, monitoring pump temperature, and pump integrity are discussed. (LEW)

15561 **(MLM—3472) Automated gas transfer systems for low pressure operations.** Baker, R.W.; Hoseus, N.L. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 22 Jan 1988. Contract AC04-76DP00053. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005241/JAW.

The introduction of new components and the modification of commercially available hardware have been instrumental in the automation of low pressure gas transfer systems. The benefits from the automation have been faster sample operation, increased precision and a safer environment for the operator.

15562 **(PB—88-118864/XAB) Prototype hydride-powered underground-mining vehicle. Open File report, May 1983-September 1984.** Baker, N.; Lynch, F. (Eimco Mining Machinery International, Salt Lake City, UT (USA)). 17 May 1985. 37p. NTIS, PC A03/MF A01.

The report describes the development, construction and testing of a hydrogen-fueled underground-mining vehicle. A hydrogen-burning engine and a hydride-fuel system, both previously developed, were installed on a modified utility vehicle, together with the necessary controls. In tests and in actual use, the vehicle performance in terms of speed, acceleration, and gradeability exceeded that of the standard, unmodified vehicle.

15563 **(PNL-SA—15260) Upgrade of the 327 Postirradiation Testing Laboratory and 324 Shielded Materials Facility.** Daubert, R.L.; DesChane, D.J. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 6p. (CONF-871101—79). NTIS, PC A02. Order Number DE88005151/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

The Pacific Northwest Laboratory operates two hot cell facilities in Hanford's 300 Area. The Post-irradiation Testing Laboratory and the Shielded Materials Facility are used for the examination and processing of irradiated fuels and materials. Major upgrades have been performed on these facilities to improve cost competitiveness, increase operational safety margins, and improve productivity. Current activities performed include irradiated fuels and materials nondestructive and destructive examinations, irradiated materials packaging and shipping, and fabrication of test specimens from irradiated materials.

15564 **(RFP—4074) The personal computer in the manufacturing environment.** Lund, D.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 7p. (CONF-870242—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005282/JAW.

From Automation Technology Institute conference; Monterey, CA, USA (10 Feb 1987).

Rocky Flats began using computers in the manufacturing environment back in 1959 with the acquisition of 13 numerically controlled lathes and a Bendix G15 computer to generate NC tapes. Since then we have greatly enhanced our APT programming system, added interactive graphics for manufacturing design and numerical control programming, implemented group technology, computer aided process planning, and manufacturing resource planning. In 1983, a distributed numerical control (DNC) pilot project was started to investigate and validate the DNC concept in the Rocky Flats manufacturing environment. Three primary DNC functions identified and selected for study were the electronic transfer and management of numerical control (NC) tape data, automatic monitoring of process and production events, and graphic display of manufacturing instructions at the machine tool. The DNC pilot system consisted of a computer system, communication network and machine tool interface units and a graphic display terminal.

15565 **(RFP—4107) Contributing to quality improvement at Rocky Flats Plant.** Halteman, E.J.; Ikle, D.N.; Lawton, B.B. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 9p. (CONF-870898—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005278/JAW.

From Joint statistical meeting; San Francisco, CA, USA (16 Aug 1987).

In the last three years the Statistical Applications group at Rocky Flats Plant (RFP) in Golden, Colorado has made significant progress towards implementing a sound quality improvement plan. The statistics group has used a combination of education, training and hands on experience to promote new thinking at the plant. The ideas have progressed over several years and go hand in hand with the new attitudes on quality now sweeping the country. In the context of immediate concerns from the manufacturing and development areas at the plant Statistical Applications at RFP developed a specific process development strategy that included basic concepts of quality improvement. This paper outlines the seemingly long road to implementation and change, documents certain specific successes and describes the plan now in progress by the statistics group for adding to the quality picture at Rocky Flats and the statisticians' role in that picture.

15566 **(SAND—86-2972) Kinematic and dynamic analyses of the Stanford/JPL robot hand.** Johnson, V.J.; Starr, G.P. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA). Dept. of Mechanical Engineering). Nov 1987. Contract AC04-76DP00789. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004637/JAW.

This report develops the kinematic and dynamic equations for one finger of the three-fingered Stanford/JPL robot hand and documents the physical parameters needed to implement the equations. The equations can be used in control schemes for position and force control of the Stanford/JPL robot hand. The output file for the MACSYMA program is given. 4 refs., 6 figs., 1 tab.

15567 **(SDR-R—368) CRACUK user's guide. (Appendix to the CRAC2 user guide).** Egan, M.J.; Nixon, W.; Brearley, I.R. (UKAEA Safety and Reliability Directorate, Culcheth). Aug 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750873/JAW.

The CRACUK computer code is a revised version of the US consequence modelling code CRAC2, adapted to suit UK applications. Modifications to various models within the code have led to certain changes in the input data requirements for CRACUK in comparison with CRAC2. This guide, written in the form of an Appendix to the CRAC2 User Guide, includes descriptions of the input data layout as it has been altered for use in CRACUK. Used in conjunction with the CRAC2 User Guide, this publication should allow easy use of the CRACUK code.

15568 **(SRD-R—380) CRITEX - a computer program to calculate criticality excursions in fissile liquid systems.** Mather, D.J.; Shaw, P.M. (UKAEA Safety and Reliability Directorate, Culcheth). Feb 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750874/JAW.

A computer program CRITEX has been developed which models criticality excursions in fissile solutions. This report describes the numerical methods used to approximate the differential equations which are used to simulate the physical behaviour. A flow diagram is given together with a description of the subroutines, input and output variables.

15569 **(STF—21A85073) Cleaning of drilled cuttings.** Wiig, P.O. (SINTEF, Trondheim (Norway)). Aug 1985. 245p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751219/JAW.

The report presents an investigation on the cleaning of drilled cuttings. When drilling oil wells, cuttings are transported to the surface by the drilling fluid. The main purpose of this project was obtain some basic information on how drilled cuttings containing oil will behave during different wash processes. It is performed tests with two different wash systems: a simulated immersion wash in a rotating drum, and a spray wash system on a vibrating screen. Wash solutions used were sea water added different surfactants and with pure sea water as reference. 87 drawings, 57 tables, 23 references.

15570 **(TPRD/M—1463/R87) Links manipulator simulation program interim report. Interim report.** Noble, R.A. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.). Apr 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750323/JAW.

A computer program to simulate the performance of the Heysham II rail-following manipulator has been developed. The program is being used to develop and test the rail-following control algorithms which will be used to control movements of the manipulator when it is operating below the gas baffle dome. The simulation includes the dynamic responses of the manipulator joint drives, excluding friction, backlash and compliance. It also includes full details of the manipulator's geometry. A method is given whereby the actual manipulator dynamics can be written into the program once these have been established by measurement. The program is written in FORTRAN and runs on a Perkin-Elmer 3220 mini-computer. The simulation program responds to velocity demands on the individual joints. These will normally come from the control program, in which they will be manually controlled by a joystick. A sigma 5664 colour graphics generator is programmed to display the current position of the manipulator.

15571 **(UCID—19899-Rev.2) DYNA3D course notes.** Hallquist, J.O. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 266p. (UCRL—53745-Rev.2). NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88005232/JAW.

15572 (UCID—21275) Status report on development activities for a 21-T superconducting magnet and cryostat. Miller, J.R.; Kerns, J.A.; Slack, D.S.; Strum, M.J.; Summers, L.T. (Lawrence Livermore National Lab., CA (USA)). 8 Dec 1987. Contract W-7405-ENG-48. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004370/JAW.

Development activities to date have emphasized the following areas: modifications to existing laboratory test equipment in preparation for an intensified test program in the next calendar year, development and fabrication of critical components for the He-II cryostats needed both for the test program and for the 21-T spectrometer cryostat, selection and characterization of insulation materials and impregnants, preparation of the mechanical analysis techniques, and characterization of pre-protypical conductors. Highlights include progress on fabrication of the model coil cryostat and the acquisition of illuminating mechanical data on both reacted and unreacted conductor samples.

15573 (UCRL—15984) Further development of a finite element model of orthogonal metal cutting: Final report. Strenkowski, J.S. (North Carolina State Univ., Raleigh (USA). Dept. of Mechanical and Aerospace Engineering). 20 Oct 1987. Contract W-7405-ENG-48. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88004048/JAW.

This report summarizes the improvement of two finite element models of orthogonal metal cutting. The research effort took place from January 1985 to September 1987. Two contracts were awarded during this period, each aimed at specific improvements to the two models. The first contract consisted of four tasks, which concentrated on the further development of a NIKE2D metal cutting model. These included the following: the criterion for separation of finite element nodes into chip and workpiece near the tool tip; the most appropriate treatment of the stress concentration near the tool tip; the addition of thermal effects to the calculations, including heating from plastic work and interfacial friction, thermoelastic-plastic material properties, internal heat conduction and free-surface heat removal; and in collaboration with the Lawrence Livermore National Laboratory (LLNL), North Carolina State University (NCSU) shall conduct parameter studies, based on the existing state of code development, for factors such as tool edge radius, rake angle, etc., aimed at comparisons with experiment and guidance of code development. The second contract called for improvements to a second type of finte element model of orthogonal metal cutting. This model is called the Eulerian model because it simulates the workpiece in the vicinity of the cutting tool as an Eulerian flow field. The tasks under this contract included the following: development of a free surface algorithm for chip geometry for the cutting model; preliminary development of a transient Eulerian cutting model; and assessment of the use of an Eulerian model to study the onset of shear band formation and built-up edge as a function of cutting conditions, such as cutting speed, depth of cut, rake angle, and material properties.

15574 (UCRL—95997) The effects of various conductor components on Nb_3Sn filament prestrain in cable-in-conduit conductors. Miller, J.R.; Summers, L.T. (Lawrence Livermore National Lab., CA (USA)). 11 Jun 1987. Contract W-7405-ENG-48. 10p. (CONF-8706125—24). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003956/JAW.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

We investigated the state of thermal prestrain in cable-in-conduit conductors modified by incorporating tungsten core wires in cable subelements. The relatively low thermal contraction and high modulus of tungsten is intended to offset the compressive thermal prestrain introduced in the conductor filaments by the differential contraction of the stainless-steel sheath, copper stabilizer, and Nb_3Sn. Critical current as a function of applied strain was measured at 12 T for conductor samples with tungsten core wires and control specimens with copper cores. The degree of thermal precompression was determined from measured ratios of initial critical current with no external strain to the maximum critical current observed with varying applied strain. 5 refs., 5 figs., 2 tabs.

15575 (UCRL—96249) $LiNbO_3$:Ti directional-coupler modulators for high-bandwidth, single-shot instrumentation systems operating at 800 nm. Lowry, M.; Jander, D.; Lancaster, G.; Kwiat, P.; McWright, G.; Peterson, R.T.; Tindall, W.; Roeske, F. (Lawrence Livermore National Lab., CA (USA)). 28 Oct 1987. Contract W-7405-ENG-48. 7p. (CONF-8708198—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003830/JAW.

From Symposium on fiber optics and integrates optoelectronics; San Diego, CA, USA (16 Aug 1987).

We update our work on optical directional-coupler modulators (ODCMs) for single-shot, analog instrumentation systems operating at ~800 nm. We can now fabricate directional-coupler devices that have one input and two output pigtails, with insertion losses of 8.9 dB on average. Data for the ODCMs indicate an impulse response of less than 40 ps. We have implemented these devices in an ultrafast, x-ray measurement system. We discuss our data from this implementation and their implications for continued ODCM development. 13 refs., 8 figs.

15576 (UCRL—97612) Advances in x-ray optics, 1987. Ceglio, N.M. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 16p. (CONF-8709216—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88003298/JAW.

From International symposium on X-ray microscopy; Long Island, NY, USA (3 Sep 1987).

This contribution is the third in a series of review articles, on recent developments in x-ray optics by the Advanced X-ray Optics Group at Lawrence Livermore National Laboratory and it's collaborators. In the past three years significant progress has been made in the development of novel x-ray sources, x-ray optical components, and x-ray detectors. 17 refs., 8 figs.

15577 (UCRL—97696) Inspection of the Large Optics Diamond Turning Machine. Patterson, S.R. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 18p. (CONF-8711122—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004000/JAW.

From 66. meeting of the IMOG Gaging Subgroup; Livermore, CA, USA (3 Nov 1987).

The Large Optics Diamond Turning Machine (LODTM) is of stacked slide design, somewhat resembling a bridge type coordinate measuring machine. In fact, the machine must serve as a measuring machine for the quality control steps of workpiece manufacture since there is not currently another method of measuring the highly aspheric parts manufactured. To calibrate the LODTM and provide an independent check of its accuracy as a measuring machine, a joint effort was mounted with a team from the National Bureau of Standards at Gaithersburg. The LODTM was tested to determine stability, repeatability and accuracy. The results given in this report are just a few of the measurements made to parameterize the performance of the machine

15578 (VTT-TIED—734) Ultrasonic testing of heat exchanger tubes. Lahdenperae, K.; Pitkaenen, J.; Lipponen, A. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jul 1987. 27p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751172/JAW.

An ultrasonic equipment for internal inspection of condenser tubes has been acquired. The testing speed is 25 mm/s if 100% coverage is required. The internal diameter of the tubes to be tested can be from 13 mm to 20 mm. Water is used as a couplant. The unaccuracy of the testing is 0.1 mm. The wall thickness exceeding 0.9 mm can be measured if the corrosion is external. The smallest holes that can be found have a 1.5 mm diameter. The equipment can be used also for analyzing results of eddy current inspection.

15579 Condensation on coolant jets and sheets including the effects of noncondensible gases. Jacobs, H.R.; Nadig, R. (Department of Mechanical Engineering, The Pennsylvania State University, University Park, PA 16802). *Journal of Heat Transfer;* **109**: No. 4, 1013-1020(Nov 1987).

The study of condensation of a pure vapor or a mixture of a vapor and a noncondensible gas on a laminar cylindrical jet or a

falling sheet can provide the necessary information for designing cascade, curtain, or jet-type direct contact condensers. Prior to the present work the only theoretical solutions were based on the solution of the Graetz problem and were thus restricted to problems where the Jakob number is zero. Using an integral formulation of the governing equations, an extension is made which provides results for practical values of both the Jakob and Graetz numbers. For the case where noncondensibles are present, detailed results are presented for the steam—air system.

15580 **Glove box operations for transplutonium element productions.** Knauer, J.B.; Alexander, C.W.; Wiggins, J.T. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* 52: 364(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Glove boxes are used in the Transuranium Processing Plant (TRU) at Oak Ridge National Lab. for (a) completing the final chemical processing steps to isolate and purify transplutonium elements, (b) packaging transplutonium elements for shipment, (c) preirradiation and postirradiation processing of samples used to produce special transplutonium isotopes in the High Flux Isotope Reactor (HFIR), and (d) conducting special projects, which include providing highly purified transplutonium products in special chemical forms and/or in experimental devices as requested by researchers. During 20 yr of operation, the quantities of transplutonium elements produced, and thus the amount of radioactivity handled, have continually increased. At the same time, substantial effort has been expended to reduce personnel radiation exposures. Equipment and techniques have been developed to maintain the desired operational capabilities in the glove boxes while keeping radiation exposures to operating personnel as low as reasonably achievable. Developments have included the design and fabrication of product handling and collection devices, product storage containers, and laminated exterior shields of lead glass, lead acrylic, acrylic sheets, polyethylene, and lead.

15581 **New approaches to glove box design at Hanford.** Lini, D.C.; Fisher, F.D.; Walters, F.F. *Transactions of the American Nuclear Society;* 52: 365-366(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Glove boxes provide the primary environmental containment system for plutonium processing operations at US Dept. of Energy (DOE)-owned facilities such as Rockwell Hanford. As noted in previous presentations, glove box designs and operations have evolved through stages that are a result of advances in processing techniques, new regulatory requirements, and cost escalation. These factors will continue to influence the current glove box designs and operations. The purpose of this presentation is to discuss required upgrades and changes that are being incorporated into glove boxes being installed at Rockwell Hanford and other DOE installations or are being evaluated for future upgrades.

4203 Lasers

REFER ALSO TO CITATION(S) 14084, 15063, 15219, 15473, 15576, 15672, 15881, 16401, 16409, 17078, 17079

15582 **(DOE/ER/13761—4) Instabilities and chaos in a multimode, standing-wave, CW dye laser.** Raymer, M.G.; McMackin, I.; Radzewicz, C.; Beck, M.; Deng, Z. (Rochester Univ., NY (USA). Inst. of Optics). 1987. Contract FG02-87ER13761. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005028/JAW.

Experimental and theoretical investigations of a multimode, standing-wave, cw dye laser have been carried out. The dye laser studied is composed of a standard three-mirror, folded cavity, a single-plate birefringent tuner, and a sapphire dye jet nozzle. The laser spectrum is found to evolve by discrete transitions with increasing pump power, between spectra composed of three stable modes to spectra composed of many modes whose amplitudes fluctuate strongly. The mode structure of the laser is power dependent varying from stable stable, unstable to quasi-continuous.

15583 **(DOE/ER/25016—6) Explicit approximations for strictly nonlinear oscillators with slowly varying parameters with applications to free electron lasers.** Kevorkian, J.; Li, Y.P. (Washington Univ., Seattle (USA). Dept. of Applied Mathematics). Aug 1987. Contract AI05-86ER25016. 75p. (TR—87-8). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004116/JAW.

The first part of this paper summarizes the mathematical modeling of free electron lasers (FEL), and the remainder concerns general perturbation methods for solving FEL and other strictly nonlinear oscillatory problems with slowly varying parameters and small perturbations. We review and compare the methods of Kuzmak-Luke and of near-identity averaging transformations. In order to implement the calculation of explicit solutions we develop two approximation schemes. The first involves use of finite Fourier series to present either the leading approximation of the solution or the transformation of the governing equations to a standard form appropriate for the method of averaging. In the second scheme we fit a cubic poly-nomial to the potential such that the leading approximation is expressible in terms of elliptic functions. The ideas are illustrated with a number of examples which are also solved numerically to assess the accuracy of the various approximations.

15584 **(LA-UR—86-3767) Impact of the Strategic Defense Initiative on research at Los Alamos National Laboratory.** Browne, J.C. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 17p. (CONF-8611102—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE87002923/JAW.

From 2. New Mexico space conference; Albuquerque, NM, USA (6 Nov 1986).

The theme of the presentation is how the Strategic Defense Initiative has impacted basic and applied research at Los Alamos National Laboratory. SDI programs count for less than 25% of the activities at LASL. Areas of research include: neutral particle beams and the free electron laser concepts.

15585 **(LA-UR—87-3092) Preliminary injector, accelerator, and beamline design for rf-linac-driven XUV free-electron lasers.** Carlsten, B.E.; Chan, K.C.D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 30p. (CONF-8709110—18). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003185/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

The proposed Los Alamos National Laboratory XUV free-electron laser (FEL) facility requires exceptional beam quality at high peak currents. Although the beam quality needed for a demonstration machine lasing at 50 nm is not far from what can be expected with extensions of present linacs to higher energy, conventional injector technology will not meet the requirements needed for lasing at 12 or 4 nm. We have conceived a preliminary injector and accelerator design that will meet these requirements. Using the Los Alamos photoelectric injector, it appears that normalized 90% emittances of 24 π dot mm dot mrad can be attained in a relatively straightforward manner, and emittances down to 4 π doe mm dot mrad are possible. Beamline simulations have been performed with the particle-pushing code PARMELA, using particle-dump inputs from the particle-in-cell code ISIS. The latter models the photoelectric gun up to the range between 0.75 and 1 MeV. Designs including electron guns with Pierce geometries have also been studied. Using an injector with a large planar-cathode Pierce gun seems to satisfy the 50-nm lasing requirements. In addition, other beamline questions have been studied. Beamline bends have been designed that are achromatic and nearly isochronous. The threshold for cumulative beam breakup and the emittance growth caused by transverse resistive-wall beam instability have been calculated. Finally, we discuss the advantages and disadvantages of building a straight-line machine versus a recycling machine, including recycling instability current levels. 11 refs., 16 figs.

15586 (LA-UR—87-4015) Bright source lasers and experiments at very high irradiance. Jensen, R.J.; Gibson, R.B.; Schappert, G.T.; Taylor, A.J.; Roberts, J.P.; Casperson, D.E.; Jones, L.A.; Kyrala, G.A.; Lee, P.H.Y.; Cobble, J.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 11p. (CONF-871093—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004317/JAW.

From 8. international workshop on laser interaction and related plasma phenomena; Monterey, CA, USA (27 Oct 1987).

The Los Alamos Bright Source has been assembled to explore the effects of intense coherent ultraviolet radiation on matter. This ultra-high brightness excimer laser is used to study the response of atoms, ions, and plasmas to the unique conditions the laser can provide. Primary areas of interest include properties and behavior of highly energetic atomic species, studies of possible intense field-induced nuclear transitions, pumping for x-ray lasers, and incoherent x-ray sources. The project consists of two phases: Los Alamos Bright Source I (LABS I) that is now in operation and is producing experimental data at an intensity up to 7×10^{17} watts/cm^2 with 25 mJ of radiation and LABS II that will deliver between .1 and 1 J at an intensity of 10^{18} to 10^{20} w/cm^2. At these high intensities we observe collisionless excitations to the KeV level. The exact nature of the excitation process is not known and is itself part of the investigation. Because of the coherent nature of the pump and the very large fields obtainable, new regimes of optical excitation can be expected and examined. Work is underway with LABS I to produce highly ionized species and measure their spectral and other properties. This equipment has proven to be highly reliable in the last year and should afford the opportunity for many basic studies. LABS II with its increased pulse energy and intensity will support studies involving larger pump volume and higher excitation levels. It should serve as a test bed for studies of pumping schemes for x-ray lasers. 6 refs., 8 figs., 3 tabs.

15587 (LA-UR—87-4214) Extension of nuclear structure data base searches for gamma-ray laser candidates. Arthur, E.D.; Madland, D.G.; George, D.C. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 4p. (CONF-880110—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004288/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

Results from a data base search of computerized nuclear structure libraries have been extended and augmented so as to expand the information available for nuclei suitable as gamma-ray laser candidates. The spectrum of nuclear levels occurring in deformed rotational nuclei have been calculated and have been used in conjunction with isomeric state data for odd-A systems. The results of this augmentation effort are presented with particular emphasis on results obtained for ^{177}Lu, ^{177}Hf, and ^{179}Hf. For these cases some possibly interesting cases were identified that met energy spacing criteria. However, significant hindrance factors exist for them which negate their interest for gamma-ray laser applications. 9 refs., 1 fig., 1 tab.

15588 (MLM—3480(OP)) Ignition and high speed photography of energetic materials with a copper vapor laser. Dosser, L.R.; Reed, J.W.; Girmann, T.C.; Stark, M.A. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 4p. (CONF-871254—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004831/JAW.

From Lasers '87; Lake Tahoe, NV, USA (7 Dec 1987).

The reactions of energetic materials are rapid and often violent and require specialized diagnostics to study them. A method recently applied to this problem is laser illuminated high speed photography with a copper vapor laser than can record up to 10,000 laser illuminated images per second. This type of laser photography has provided images that detail the performance of a material or component in a manner never before possible. The copper vapor laser can also be used for the ignition of energetic materials. Details of such ignitions are readily observable, and the burn rate of the material can be determined directly from the film. There are indications that information useful for the modeling of energetic material reactions will become available as well. Recent results on several materials, including Ti/2B, a pyrotechnic torch, and the explosive hexanitrostilbene, are presented.

15589 (SAND—87-3055C) Pulse-train amplification of subnanosecond near-transform-limited KrF laser pulses. Raymond, T.D.; Reisner, C.; Adams, R.G.; Michie, R.B.; Woods, C. (Sandia National Labs., Albuquerque, NM (USA); Mission Research Corp., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-880110—11). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004460/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

Extraction of energy in the form of a train of subnanosecond pulses from a discharge-pumped KrF excimer amplifier is shown to be an efficient means of enhancing the intensity of the laser radiation. The effect of interpulse time separation and pulse width have been investigated experimentally. Intensity enhancements of up to 7x above steady-state, with extraction efficiencies in excess of 60% of the steady-state value, were obtained by amplifying a train of 0.4-nsec full-width-at-half-maximum (FWHM) pulses separated by 5 nsec.

15590 (SAND—87-3071C) Polarization effects in laser-pumped Nd:YAG lasers. Esherick, P.; Owyoung, A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-880110—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004019/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

Our investigations into the polarization properties of mechanically-stressed monolithic Nd:YAG oscillators have led to two important discoveries. First is the applicability of mechanical stress as a means for rapidly tuning the output frequency of a single-mode monolithic oscillator. The second, quite unexpected, discovery is that the polarization emitted by such a Nd:YAG oscillator is strongly dependent on both the polarization and precise wavelength of the (nominally 800 nm wavelength) pump radiation. 8 refs., 3 figs.

15591 (SAND—87-3074C) Quenched-laser operation of a Littman dye oscillator. Raymond, T.D.; Reiser, C.; Esherick, P.; Michie, R.B. (Sandia National Labs., Albuquerque, NM (USA); Mission Research Corp., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-880110—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004020/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

We demonstrate a means of generating narrowband, tunable laser pulses near 650 nm with continuously adjustable pulse width from 0.2 to 3 nsec. The system utilizes a short-cavity single-mode Littman oscillator which is quenched by a second short-cavity dye laser. Both are pumped by the same 6-nsec full-width-at-half-maximum (FWHM) frequency-doubled single-mode Nd:YAG laser. We also demonstrate a polarization technique in the three-stage amplification of these pulses to an energy of 20 mJ with minimum temporal broadening. 9 refs., 3 figs.

15592 (UCRL—15972) Growth of Cr,Nd:$Gd_3Sc_2Al_3O_{12}$ (Cr,Nd:GSAG) crystals by the heat exchanger method (HEM): Final report, December 1, 1984-March 31, 1986. Khattak, C.P.; Schmid, F.; Scoville, A.N. (Crystal Systems, Inc., Salem, MA (USA)). 31 Mar 1987. Contract W-7405-ENG-48. 36p. (CSI—87-R-1004). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004041/JAW.

The feasibility of growth of Cr,Nd:$Gd_3Sc_2Al_3O_{12}$ (Cr,Nd:GSAG) crystals by the Heat Exchanger Method (HEM) has been demonstrated. Core-free crystals of optical quality have been produced. Even with unseeded growth 2 cm diameter grains have been obtained. Procedures have been developed to minimize growth striations in the crystals. Secondary phases were formed during unseeded growth of large charges when growth was carried

out under high temperature gradients. Procedures were developed to nucleate the stoichiometric phase and sustain this phase during growth. This can be achieved by seeded growth which is necessary to obtain oriented, large single crystals of Cr,Nd:GSAG. Spectroscopic measurements have shown extraneous absorption, which can be eliminated by post-growth annealing of crystals in an oxidizing atmosphere. This absorption is related with oxygen-vacancy related defects which are common in the mixed oxide crystals. It has been demonstrated that a development effort in producing Cr,Nd:GSAG crystals would lead to growth of large, optical quality crystals for laser applications. 10 refs., 13 figs.

15593 **(UCRL—15981) High power, high efficiency 770 nm 2D laser diode array.** Rosenberg, A.; McShea, J.C.; Bogdan, A.R.; Petheram, J.C.; Rosen, A.; Bechtle, D.; Zory, P.S.; Sprague, J.W. (General Electric Co., Princeton, NJ (USA). Astro-Space Div.; David Sarnoff Research Center, Princeton, NJ (USA); General Electric Co., Syracuse, NY (USA). Electronics Lab.). Nov 1987. Contract W-7405-ENG-48. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004043/JAW.

A 2D laser diode array is described which operates at a power density of 2kw/cm², with an overall efficiency of 35% and a slope efficiency of 56%. The wavelength of operation is 770 nm. 6 refs., 4 figs.

15594 **(UCRL—15997) Phosphorus oxynitride glass for laser applications: Final report, 1 February 1987-30 June 1987.** Day, D.E. (Missouri Univ., Rolla (USA)). Sep 1987. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005413/JAW.

This report describes an investigation undertaken to improve the chemical durability of Nd-doped phosphate laser glasses by nitridation in dry NH_3. The one extra bond provided by the nitrogen ion increases the cross-link density in the glass network, thereby imparting more stability. The general plan was to remelt glass cullet in anhydrous ammonia vapor at predetermined temperatures for different times for the purpose of producing an oxynitride glass. The chemical durability along with other properties, such as the refractive index, thermal expansion coefficient, and dilatometric softening temperature, were measured and compared for the unnitrided and oxynitride glasses. Unlike many phosphate glasses, the chemical durability of the LLNL laser glasses in the ambient atmosphere is reasonably high and is comparable to commercial soda-lime-silica glass. Only a small amount (<0.2 wt %) of nitrogen could be incorporated into these glasses by remelting in dry ammonia. This amount is insignificant compared to the 10 to 15 wt % nitrogen that has been incorporated into a sodium-metaphosphate glass under identical nitriding conditions. No significant change in refractive index, thermal expansion coefficient, dilatometric softening temperature, and chemical durability was detected for the nitrided and unnitrided glasses. The presence of R_2O_3 oxides (R = Al, La, Nd) is believed to be the reason for the very low nitrogen content in these oxynitride phosphate laser glasses. Since the strength of R-O bond is higher than that of the R-N bond, the replacement of an oxygen attached to Al, La, or Nd by nitrogen in the glass network seems unlikely. This concept has been confirmed by nitriding a $40N_2O$-$60P_2O_5$, mol %, glass where the nitrogen content was found to rapidly decrease with increasing Nd_2O_3 content in the glass. 11 refs., 3 figs., 8 tabs.

15595 **(UCRL—21009-Pt.2) Reactions of $N_2(A^3\Sigma/sub\ u/^+)$ and candidates for short wavelength lasers.** Setser, D.W. (Kansas State Univ., Manhattan (USA). Dept. of Chemistry). 7 Dec 1987. Contract W-7405-ENG-48. 42p. NTIS, PC A03. Order Number DE88005366/JAW.

This proposal is a request for a one year renewal of a contract with the Univ. of California (Lawrence Livermore Laboratory). The proposed experiments are directed towards investigation of possible short-wavelength laser candidate molecules that can be pumped via excitation-transfer reactions with $N_2(A^3\Sigma/sub\ u/^+)$ molecules. We will continue our flowing-afterglow experiments to characterize the excitation-transfer collisions between $N_2(A)$ and promising acceptor diatomic molecules (radicals). We also will extend the studies to include excitation-transfer to Cd and to S atoms. For some chemical systems, a pulsed $N_2(A)$ source would be very convenient for kinetic measurements and we propose to develop a pulsed $N_2(A)$ source. During the first year, we have shown that the excitation-transfer reaction between $N_2(A)$ and SO(X) provides a possible laser candidate. Therefore, we propose to start a program to study the quenching and relaxation kinetics of the $SO(A^3PI)$ molecule, using pulsed laser excitation techniques to generate specific levels of $SO(A^3PI)$.

15596 **(UCRL—95880) Fracture mechanisms and strengthening of slab lasers.** Marion, J.E. (Lawrence Livermore National Lab., CA (USA)). Jan 1987. Contract W-7405-ENG-48. 14p. (CONF-870132—18). NTIS, PC A03. Order Number DE88004002/JAW.

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

The fracture mechanisms of slab lasers are examined and the critical defects, induced during optical fabrication, are identified. A rationale for determining an appropriate operating stress for the slab laser is outlined, based on Weibull statistics, and this method is experimentally assessed in full-sized slab fracture tests. Techniques for achieving strong slabs are then examined. We determine that strengthening by subsurface damage minimization has the highest potential for strengthening, but that slab durability must also be enhanced in order for the slab to remain strong in practice. Good chemical durability is achieved by the use of water-proof overcoats. Good mechanical durability is achieved by the use of compressive surface layers. The compressive surface layers prevent the deterioration in slab strength from physical damage to the slab surface.

15597 **(UCRL—95969) Soft x-ray beamsplitters and highly dispersive multilayer mirrors for use as soft x-ray laser cavity components.** Hawryluk, A.M.; Ceglio, N.M.; Stearns, D.G.; Danzmann, K.; Kuehne, M.; Muller, P.; Wende, B. (Lawrence Livermore National Lab., CA (USA); Physikalisch-Technische Bundesanstalt - Inst. Berlin (Germany, F.R.)). 12 Jan 1987. Contract W-7405-ENG-48. 12p. (CONF-860880—57). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004003/JAW.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The demonstration of amplified spontaneous emission at soft x-ray wavelengths has highlighted the need for normal incidence optics for soft x-rays. Specifically, x-ray laser cavity components will be needed to further advances in x-ray laser research. In this paper, we present the fabrication, characterization and analysis of two possible cavity components, an x-ray beamsplitter and a highly dispersive multilayer mirror. Each of these can be used as x-ray laser cavity output couplers. 7 refs., 10 figs., 2 tabs.

15598 **(UCRL—97706) Experimental results of a high-gain microwave FEL operating at 140 GHz.** Throop, A.L.; Fawley, W.M.; Jong, R.A.; Orzechowski, T.J.; Prosnitz, D.; Scharlemann, E.T.; Stever, R.D.; Westenskow, G.A.; Hopkins, D.B.; Sessler, A.M. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA); Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 12 Nov 1987. Contract W-7405-ENG-48. 22p. (CONF-8709110—17). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004358/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

The Electron Laser Facility (ELF) at LLNL has been used to generate high peak-powers at 140 GHz, extending the operating range of the device from previous experiments at 35 GHz. With 30 watts of input signal, an exponential gain of 21 dB/m and a saturated output power of over 50 MW were measured. Numerical tapering studies indicate that space charge effects were sufficiently large to affect trapping efficiency. Broadband spontaneous emission was observed over a wide range of wiggler fields at frequencies corresponding to FEL resonance. Over 150 MW of spontaneous power was measured near 94 GHz. The results are in good agreement with particle simulation codes. 4 refs., 9 figs.

15599 **Mode structure of the p-germanium far-infrared laser with and without external mirrors: Single line operation.** Unterrainer, K.; Helm, M.; Gornik, E.; Haller, E.E.; Leotin, J. (Institut fuer Experimentalphysik, Universitaet Innsbruck, A-6020 Innsbruck, Austria). *Applied Physics Letters;* **52**: No. 7, 564-566(15 Feb 1988).

The mode structure of p-Ge far-infrared lasers with and without mirrors is investigated. Without external mirrors a multimode spectrum is observed and quantitatively explained in terms of waveguidelike modes. An external resonator drastically reduces the number of oscillating modes. For the first time single line operation is demonstrated in this configuration.

15600 **Multipass amplification of soft x rays in a laser cavity.** Ceglio, N.M.; Stearns, D.G.; Gaines, D.P.; Hawryluk, A.M.; Trebes, J.E. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Optics Letters;* **13**: No. 2, 108-110(Feb 1988).

We report the first demonstration to our knowledge of multipass amplification of soft x rays. A gain medium of neonlike selenium ions was placed within a resonant cavity composed of a multilayer mirror and a beam splitter designed for normal-incidence use at the 20.63- and 20.96-nm laser lines of the neonlike selenium. The laser-cavity output was time resolved and exhibited three distinct temporal components identifiable as the single-, double-, and triple-pass amplified emission. In these experiments, multipass amplification was limited by the finite duration of the gain medium.

15601 **Resonance enhancement of optoacoustic signal for frequency stabilization of CO_2 laser pump for CH_3OH FIR laser.** Fishback, J.R.; Azar, M.; Ventrice, C.A.; Hutchinson, D.P. (Electrical Engineering Department, Tennessee Technological University, Cookeville, Tennessee 38505). *Review of Scientific Instruments;* **59**: No. 2, 238-241(Feb 1988).

The resonance enhancement of an optoacoustic signal, generated in methyl alcohol vapor, is investigated with the objective of obtaining a reliable discriminator at reduced pump power levels. The 9P(36) pump line from a CO_2 laser is used throughout the study. The optoacoustic signal strength and resonator Q are measured at the fundamental longitudinal resonant frequency for various resonator geometries and vapor pressures. Resonators of length ranging from 12 to 24 cm are examined for tubes of inner diameter 7.5, 9.5, and 10.6 mm. The maximum vapor pressure for which a reliable discriminator is obtained is found to be 1 Torr. Both the optacoustic signal strength and the resonator Q increase with increasing vapor pressure and decreasing resonator length. The highest Q is obtained for the 10.6-mm-i.d. tubes. Using a resonator of the length 14 cm and 10.6-mm i.d. at a vapor pressure of 1 Torr, it is found that a pump power as low as 0.4 W gives a reliable discriminator.

15602 **Mode control in broad-area diode lasers by thermally induced lateral index tailoring.** Hohimer, J.P.; Hadley, G.R.; Owyoung, A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **52**: No. 4, 260-262(25 Jan 1988). Contract AC04-76DP00789.

Broad-area diode lasers that emit in the fundamental mode under short-pulse excitation are observed to evolve into higher order lateral modes with increasing pulse width. Our data provide convincing evidence that the lateral refractive index profile arising from junction heating plays a dominant role in determining the lateral emission modes in these devices for long-pulse and cw operation. Furthermore, we show that an external focused laser heat source can be used to modify the lateral index profile in a broad-area laser and thus control the lasing mode. In particular, we demonstrate that approx. <50 mW of absorbed heating power is sufficient to counteract the effects of internal junction heating and restore fundamental mode operation at cw injection currents as high as 1.5 I/sub threshold/. Our results suggest that fundamental mode operation of broad-area devices at high-power levels might be realized by incorporating a tailored lateral index profile to compensate for internal junction heating.

15603 **Two-photon pumped CO B-A laser.** Tiee, J.J.; Quick C.R. Jr.; Loge, G.W.; Wampler, F.B. (Chemical and Laser Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **63**: No. 2, 288-290(15 Jan 1988).

An optically pumped CO laser that involves a two-photon excitation of the B state is described. A photon conversion efficiency of 15% is determined for the 0-1 and 0-2 vibraonic transitions of the B-A system. It appears that the major portion of the emitted light is the result of amplified spontaneous emission due to the high gain of the transition.

15604 **Wavelength tuning and switching of a coupled distributed feedback and Fabry—Perot cavity laser.** Wu, M.C.; Boenke, M.M.; Werner, M.; Schiffmann, F.; Lo, Y.H.; Wang, S. (Department of Electrical Engineering and Computer Sciences, Electronics Research Laboratory and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Applied Physics;* **63**: No. 2, 291-294(15 Jan 1988).

We present a theoretical analysis of a newly demonstrated semiconductor laser with coupled distributed feedback and Fabry—Perot (DFB-FP) cavities and show that three modes of operation are possible for such a laser. In mode-switched DFB mode, the wavelength can be switched between longitudinal modes on either side of the stopband. In coupled-cavity laser mode, there are successive mode hops inside the stopband. Finally, in continuously tunable distributed Bragg reflector mode, a wide wavelength tuning range (4.8 A) without mode hopping can be obtained. The analysis is general enough to be applied to any laser with a periodic waveguide section, and provides an understanding of the mechanisms and the limits of wavelength tuning in such lasers. This type of laser has very important applications in coherent optical communications.

15605 **Decay of the first triplet Kr_2 excimer in the presence and absence of N_2 and effects of N_2 on the decay constant and excimer yield at 298 K.** Firestone, R.F.; Selander, W.E. (Department of Chemistry, The Ohio State University, Columbus, Ohio 43210). *Journal of Chemical Physics;* **88**: No. 2, 717-721(15 Jan 1988).

The optical absorbance of Kr_2 (^{3}summation$^+$/sub u/)(1/sub u/,0$^-$/sub u/) at 984 nm has been measured as a function of time at 250 to 1100 Torr in pure krypton and in the presence of N_2 at 800 Torr of krypton at 298 K. The decay constant is given by 2.53 (+- 0.19)10^6 + 194(+- 84)P/sub Kr/ s^{-1} in the absence of N_2. The rate constant for electronic quenching by N_2 is 7.65(+- 0.34)10^{-13} cm^3 s^{-1}. All observations are consistent with the formation of a long-lived "bottleneck" species associated kinetically with the Kr($1s_5$) state as proposed by Bonifield et al. The bottleneck is essentially unaffected by the presence of N_2 below 10 Torr. It is suggested that the bottleneck species is a bound molecular state which correlates with one of the Kr(2p) atomic states in the separated atom limit.

15606 **Experimental results on a gas-loaded, free-electron laser.** Feinstein, J.; Fisher, A.S.; Reid, M.B.; Ho, A.; O-dieresiszcan, M.; Dulman, H.D.; Pantell, a.R.H. (Electrical Engineering Department, Stanford University, Stanford, California 94305). *Physical Review Letters;* **60**: No. 1, 18-20(4 Jan 1988).

Wavelength tuning of 0.4 μm has been obtained by the addition of 100 Torr of H_2 gas to a vacuum free-electron laser operating in the near infrared. This experiment demonstrates that a relativistic electron beam from an rf linac can propagate in a partially ionized gas with sufficient quality to achieve free-electron laser action. The picosecond pulse structure of the beam is believed responsible for the avoidance of plasma instabilities. Gain and wavelength measurements are consistent with theoretical expectations.

15607 **Beam optics of exploding foil plasma x-ray lasers.** London, R.A. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physics of Fluids;* **31**: No. 1, 184-192(Jan 1988). Contract W-7405-ENG-48.

In soft x-ray lasers, amplification is achieved as the x rays propagate down a long narrow plasma column. Refraction, due to electron density gradients, tends to direct the x-rays out of high density regions. This can have the undesirable effect of shortening the distance that the x ray stay within the plasma, thereby limiting the amount of amplification. The exploding foil design lessens refraction, but does not eliminate it. In this paper, a quantitative analysis of propagation and amplification in an exploding foil x-ray laser is presented. The density and gain profiles within the plasma are modeled in an approximate manner, which enables considerable analytic progress. It is found that refraction introduces a loss term to the laser amplification. The beam pattern from a parabolic gain profile laser has a dominant peak on the x-ray laser axis. The pattern from a quartic gain profile having a dip on-axis can produce a profile with off-axis peaks, in better agreement with recent experimental data.

15608 **Stress-induced tuning of a diode-laser-excited monolithic Nd:YAG laser.** Owyoung, A.; Esherick, P. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Optics Letters;* **12**: No. 12, 999-1001(Dec 1987). Contract AC04-76DP00789.

We report the application of a stress-induced change in the cavity of a monolithic Nd:YAG laser as a means for precisely tuning the laser's emission frequency. By using a piezoelectric transducer to vary the applied stress, we can scan the laser emission frequency rapidly and monotonically over as much as 76.5 GHz. As a consequence of the stress-induced birefringence, the device can also be operated simultaneously in two orthogonally polarized modes that exhibit different tuning rates with applied stress.

15609 **Side-arm phase-conjugated laser.** Fukuda, R.C.; Chandra, S. (to Secretary of the Army, Washington, DC). US Patent 4,709,368. 24 Nov 1987. Filed date 24 Sep 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A phase-conjugated Q-switched laser is described including: a starter cavity defined by opposed reflectors; a laser active material in the starter cavity; a pump for the laser active material; a side-arm containing a phase conjugate mirror consisting of a lens and a stimulated Brillouin scattering cell; means for optically coupling the starter cavity to the side-arm and including a quarterwave plate and a polarizer in the starter cavity, wherein the cell acts as a Q-switch by undergoing stimulated Brillouin scattering when the laser active material is pumped by the pump and a laser beam of sufficient power is reached.

15610 **Classical and semiclassical calculation of nuclear-electron coupling.** Noid, D.W.; Hartmann, F.X.; Koszykowski, M.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 69-74(25 Sep 1987). (CONF-861038—). Contract AC05-84OR21400.

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

Energy transfer processes between an excited nuclear proton and an inner core electron are studied semiclassically. The coupled independent particle models exhibit large spectral perturbations.

15611 **Nuclear interlevel transfer driven by collective outer shell electron oscillations.** Rinker, G.A.; Solem, J.C.; Biedenharn, L.C. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 75-86(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

We discuss the general problem of dynamic electron-nucleus coupling, and the possibility of using this mechanism to initiate gamma-ray lasing. Single-particle and collective mechanisms are considered. The problems associated with accurate calculation of these processes are discussed, and some numerical results are given. Work in progress is described.

15612 **Why gamma rays are different. Some notes for pedestrians.** Lipkin, H.J. (High Energy Physics Division, Argonne National Laboratory, Argonne, IL 60439). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 90-97(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

This talk brings the discussion of gamma ray lasers down from the science fiction level to the real world. Flamboyant exciting proposals presented with evangelical zeal obscure the real difficulties to be overcome before a gamma ray laser becomes feasible in the laboratory, and long before any practical applications. Nuclear gamma radiation does not have many of the properties taken for granted in atomic or molecular radiation and necessary for lasers. The basic science and technology underlying these differences and the proposed methods of overcoming difficulties resulting from them are not properly understood. Grandiose proposals for grasers generally presented tend to ignore them. Considerable illumination in this interdisciplinary problem could be provided by some back-of-the-envelope calculations and simple experimental surveys by small groups of students and postdocs with an elementary knowledge of the nuclear and solid state physics which is evidently not familiar these days to laser physicists. However, nobody seems ready to propose or undertake such work. Unfortunately, budgets for unglamorous basic science are being cut across the board, and evangelical glamour seems to be more effective than real physics in obtaining support.

15613 **Large Nd,Cr:GSGG boule growth and quality.** Stokowski, S.E.; Shinn, M.D.; Randles, M.; Dawes, D. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 118-119(25 Sep 1987). (CONF-861038—). Contract W-7405-ENG-48.

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

Gadolinium scandium gallium garnet (GSGG) has been grown in boules of 13-cm diameter by 15 cm long. Three scale-up issues have been identified and progress made toward their solution. Large slabs of Nd,Cr:GSGG are now being fabricated for efficient, medium power lasers.

15614 **Single crystal $Na_3Ga_2Li_3F_{12}:Cr^{3+}$ laser pumped laser experiments.** Caird, J.A.; Staver, P.R.; Shinn, M.D.; Guggenheim, H.J.; Bahnck, D. (University of California, Lawrence Livermore National Laboratory, P.O. Box 5508, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 120-123(25 Sep 1987). (CONF-861038—). Contract W-7405-ENG-48.

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

We report for the firt time tunable quasi-CW lasing from single crystal $Na_3Ga_2Li_3F_{12}:Cr^{3+}$. A free lasing wavelength of 791 nm and a tuning range from 741 nm to 841 nm was obtained. Measurements of the slope efficiency, and gain and loss coefficients are reported.

15615 **Nonlinear refractive index measurements of glasses and crystals.** Adair, R.; Chase, L.L.; Payne, S.A. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 124-127(25 Sep 1987). (CONF-861038—). Contract W-7405-ENG-48.

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

We have measured the nonlinear index for numerous glasses and crystals with the goal of determining the material properties that contribute to the magnitude and dispersion of n_2. We have found that a nearly-degenerate three-wave-mixing (TWM) process, similar to that first used by Maker and Terhune, is the most useful method since it can provide both rapid and accurate n_2 measurements.

15616 **Thermo-optical modeling of flashlamp-pumped Zig-Zag labs.** Gelinas, R.J.; Doss, S.K.; Murty, S.S. (Lawrence Livermore National Laboratory). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 136-138(25 Sep 1987). (CONF-861038—). Contract W-7405-ENG-48.

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

This article describes the thermo-optical mechanics of wave front phase distortions in flashlamp-pumped, convectively cooled zig-zag slabs. We identify, from both computations and laboratory measurements, the causes of beam phase distortions that are frequently observed in output beams from zig-zag slabs.

15617 **X-ray characterization of picosecond laser plasmas.** Landen, O.L.; Campbell, E.M.; Perry, M.D. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 157-162(25 Sep 1987). (CONF-861038—). Contract W-7405-ENG-48.

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

Short-lived plasmas, produced by focussing a 0.58 μm, 1 ps, 1 mJ dye laser beam to 10^{13}—10^{14} Wcm^{-2} onto solid planar targets, are diagnosed by a photoconductive detector, pinhole camera, x-ray streak camera and by shadowgraphy.

15618 **Diffusive and convective evaporation of irradiated droplets.** Armstrong, R.L.; Zardecki, A. (New Mexico State University, Physics Department, Las Cruces, NM 88003). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 532-533(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

Numerical calculationsns are presented for aerosol-laser beam interactio over a range of beam irradiances from very weak beams to high flux beams where explosive droplet vaporization occurs. (AIP)

15619 **Self-similar approach to the explosion of droplets by a high energy laser beam.** Chitanvis, S.M. (Los Alamos National Laboratory, Theoretical Division, P-371, Los Alamos, New Mexico 87544). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 534-536(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

We have constructed a model in which a small droplet is exploded by the absorption of energy from a high energy laser beam. The beam flux is so high that we assume the formation of a plasma. We have a single-fluid model of a plasma droplet interacting with laser radiation. Selfsimilarity is invoked to reduce the spherically symmetric problem involving hydrodynamics and Maxwell's equations to quadrature. We show analytically that our model reproduces in a qualitative manner certain features observed experimentally by Eickmans et al.

15620 **Introduction to the theory of free electron lasers.** Krinsky, S. (National Synchrotron Light Source, Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 1, 1015-1043(25 Feb 1987). (CONF-850771—).

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

We present an introduction to some fundamental aspects of the theory of free electron lasers. Spontaneous radiation emitted by electron traversing a wiggler magnet is briefly reviewed, and stimulated emission in the low-gain regime is discussed using Colson's pendulum equations and Madey's theorems. The high-gain regime is treated by an extension of the work of Bonifacio, Pellegrini, and Narducci. We introduce dynamical variables to describe the radiation field, and a Hamiltonian formulation of Maxwell's equations is employed. A canonical transformation to the interaction representation factors out the fast time variation of the radiation field, and the slow time dependence is determined by linearized equations for the appropriate collective variables. As an application of this technique we consider self-amplified spontaneous radiation, and we comment upon the relationship between our approach and the use of coupled Vlasov—Maxwell equations.

15621 **Recent developments in free-electron lasers.** Brau, C.A. (Los Alamos National Lab., Los Alamos, NM). *Laser Focus with Fiberoptic Technology;* **23**: No. 2, 40-47(Feb 1987).

Recent progress in free-electron lasers is due to such advantages as tunability and ability to operate at high power. With developments in new accelerator technologies, such as linacs, wiggler magnets, and electron storage rings, shorter wavelengths may be obtained as well as better electron-beam quality. Improved performance will make possible applications in the fields of medicine, chemistry, physics, materials, and solid-state physics.

15622 **Observation of retrograde propagation of laser-driven discharges.** Allison, S.W.; Cates, M.R.; Gillies, G.T. (Oak Ridge Gaseous Diffusion Plant, Enrichment Technology Applications Center, Oak Ridge, TN 37831). pp vp. of The fifth international congress on applications of lasers and electrooptics (Technical Digest). Toledo, OH; Laser Institute of America (1986). (CONF-861197—).

From ICALEO '86: laser application conference; Arlington, VA, USA (10 Nov 1986).

Recent experiments in the authors' laboratories on laser-induced fluorescence have led to the consideration of the limiting fluences which can be sustained in various types of optical fibers. As a result of these studies, it became clear of silica core fibers could not be expected. Therefore, they began investigations of liquid core optical fibers which, in principle, should be "self-healing" and have, then, much higher damage thresholds. The authors' first experiments used small diameter glass tubes 8 cm long, 3 mm outer diameter and with a 1 mm bore. A sample tube was positioned axially inside a pair of telescoping glass tubes. These outer tubes were sealed together through o-rings, and their outside ends were sealed with optical windows about 3 mm thick. This assembly was then filled with distilled water and mounted on a multiaxis positioner on an optical table. Pulses from a frequency doubled Nd:YAG laser was focused through one window of this assembly to a point about 1 cm down the length of the sample tube. The focal length of the coupling lens was 5 cm. The pulse repetition rate was approximately 10 per second. The authors repeated this experiment with carbon tetrachloride and again observed the retrograde discharge, both with and without damage to the cell's optical window.

15623 **Liquid-core fiber optics: Transmission and nonlinear effects.** Allison, S.W.; Cates, M.R.; Gillies, G.T. (Enrichment Technology Applications Center, Oak Ridge Gaseous Diffusion Plant, P.O. Box P, Oak Ridge, TN 37831). pp vp. of The fifth international congress on applications of lasers and electrooptics (Technical Digest). Toledo, OH; Laser Institute of America (1986). (CONF-861197—). Contract AC05-84OR21400.

From ICALEO '86: laser application conference; Arlington, VA, USA (10 Nov 1986).

The authors are engaged in studies of liquid-core optical fibers for various transmission and sensing applications. Liquid waveguides exhibit a number of interesting characteristics which can be exploited. Previous researchers have carried out investigations along two main lines. The first concerned communications where low mass transmission over long distances was the objective. Losses as low as 20 dB/km were demonstrated using carbon tetrachloride. The other line of investigation, which is still active, involves exploiting the capacity of liquid waveguides to propagate and enhance nonlinear effects with communications, spectroscopic, and sensing applications in mind.

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REFER ALSO TO CITATION(S) 14141, 14497, 14568, 14709, 15536, 15618, 15619

15624 **(AD-A—185499/1/XAB) Methods for reducing computational costs of typical finite-element unsteady hydrodynamic models. Final report, February 1986-September 1987.** Baker, A.J.; Manhardt, P.D.; Johnson, B.H. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Hydraulics Lab.). Sep 1987. 67p. (WES/MP/HL—87-5). NTIS, PC A04/MF A01.

Ideas suggested to reduce computational costs of typical finite-element hydrodynamic codes are presented for implementation. Short-term suggestions include employing iterative solution solvers with perhaps a multigrid algorithm, uncoupling the governing equations and using linear interpolation for velocity to reduce the size of the coefficient matrix, and using explicit time integration with a condensed coefficient matrix. A top-down algorithm/code design from theory through to parallel processing is presented as a long-term solution. A tensor-product solution on at least a semi-regular block structured grid is proposed. With the finite-element algorithm derived from the Taylor weak statement, stabilizing mechanisms are embedded such that selective dampening of the spurious short-wavelength error modes is realized without a degradation of solution accuracy. Three-dimensional finite element hydrodynamic models based upon these concepts will result in cost-effective solutions that possess good stability properties, yet yield accurate solutions in high gradient regions.

15625 **(AD-A—185631/9/XAB) Multitasked embedded multigrid for three-dimensional flow simulation. Final report.** Johnson, G.M.; Swisshelm, J.M.; Pryor, D.V.; Ziebarth, J.P. (Institute for Scientific Computing, Fort Collins, CO (USA)). Jun 1986. 8p. NTIS, PC A02/MF A01.

This project explored fast algorithms for Euler and Navier-Stokes simulations. A particular issue pursued under the grant was the integration of an explicit three dimensional flow solver, embedded mesh refinements, a model equation hierarchy, multiple grid acceleration and extensive rectorization and multi tasking. Several papers were produced during this effort including such titles as Multitasked embedded multigrid for three-dimensional flow simulation and Multigrid approaches to the Euler equations. An efficient algorithm designed to be used for Navier-Stokes simulations of complex flows over complete configurations is described. The algorithm incorporates a number of elements, including an explicit three-dimensional flow solver, embedded mesh refinements, a model equation hierarchy ranging from the Euler equations through the full Navier-Stokes equations, multiple-grid convergence acceleration and extensive vectorization and multitasking for efficient execution on parallel-processing supercomputers. Results are presented for a preliminary trial of the method on a problem representative of turbomachinery applications. Based on this performance data, it is estimated that a mature implementation of the algorithm will yield overall speedups ranging as high as 100.

15626 **(AERE-R—12279) Proposed entrainment correlation.** Owen, D.G.; Hewitt, G.F. (UKAEA Atomic Energy Research Establishment, Harwell. Thermal Hydraulics Div.). Jun 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750833/JAW.

An extensive comparison between the predicted results of several entrainment correlations and recently obtained equilibrium film flowrate data showed that none of these correlations gave accurate predictions. There is a critical film flowrate in adiabatic flows below which no entrainment occurs, irrespective of how high the gas rate is raised. A new entrainment correlation is proposed which accounts for this critical film flowrate. The correlation is a modification of one previously suggested by Ishii and Mishima (1981) and predicts a wide range of air-water data. The correlation demonstrates how correlations can be substantially improved through consideration of the critical film flowrate.

15627 **(AERE-R—12422) Further comparisons of critical heat flux correlations for vertical tubes.** Govan, A.H. (UKAEA Atomic Energy Research Establishment, Harwell. Thermal Hydraulics Div.). Nov 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750949/JAW.

An earlier report by Govan (1984, AERE-R11298), described a data-bank of critical heat flux measurements in vertical upflow in tubes, and compared the predictions of the Harwell Annular Flow Model with two previously reported correlations. In this report two further correlations, those of Biasi [1967, Studies on burnout, Part 3] and Zuber [1961, Int. Devel. Heat Transfer, Part 2, PB230-236]/ Griffith,[1977, Nucl. Safety vol 18, no3] have been tested. These two correlations are used extensively in reactor design. Overall comparisons are given between all the correlations tested so far.

15628 **(CLM-R—276) Some calculations of shocks and detonations for gas mixtures.** Fletcher, D.F.; Thyagaraja, A. (UKAEA Culham Lab., Abingdon). Mar 1987. 35p. NTIS (US Sales Only), PC A03/MF A01 - H.M. Stationery Office, London, price Pound 5.00. Order Number DE88751826/JAW.

A computer code (CULDESAC) developed to model the flow of a mixture of two gases is reported. This is the first stage in the development of a code for modelling the detonation stage of vapour explosions. The equations governing this situation are described along with the numerical scheme developed to solve them. Calculations are presented for a steady-state shock, transient simulations of shock tubes (in one case containing different gases in each section) and detonations. It is concluded that the numerical scheme presented in the paper is suitable for the simulation of compressible flows encountered in the detonation stage of vapour explosions.

15629 **(CONF-870102—30) An experiment to investigate Rankine cycle two-phase microgravity issues.** Yoder, G.L. Jr.; Brewer, E.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004197/JAW.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

An experiment is being developed to investigate two-phase flow and heat transfer behavior under the microgravity conditions of space. The experiment is designed to be carried out utilizing the NASA standard Get Away Special (GAS) canister to be flown on a future space shuttle flight. The experiment contains a full two phase flow boiling loop, and will determine the effect of microgravity conditions on nucleate boiling heat transfer and critical heat flux values as well as examine liquid/vapor separation processes. This paper describes the experiment designed to be flown on the shuttle as well as a similar ground test loop presently being operated. In addition, initial data from the ground system is presented. Data taken thus far in upflow show increasing critical heat values with increasing test section velocity and inlet subcooling. 21 refs., 9 figs.

15630 **(CONF-871252—1) Experimental investigation of low gravity two-phase flow behavior.** Yoder, G.L. Jr.; Brewer, E.D.; Hardy, J.E.; Jatko, W.B.; Nodine, R.N. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003779/JAW.

From International symposium on thermal problems in space-based systems; Boston, MA, USA (13 Dec 1987).

An experiment is being developed to investigate two-phase flow and heat transfer behavior under the microgravity conditions of space. The experiment is designed to be carried out utilizing the NASA standard Get Away Special (GAS) canister to be flown on a future space shuttle flight. The experiment contains a full two phase flow boiling loop and will determine the effect of microgravity conditions on nucleate boiling heat transfer and critical heat flux values as well as examine liquid/vapor separation processes. This paper describes the experiment designed to be flown on the shuttle and a similar ground test loop presently being operated. In addition, initial data from the ground system is presented.

15631 **(ENEA-RT-TERM—87-1) CHF during flow rate, pressure and power transients in heated channels.** Celata, G.P.; Cumo, M. (ENEA, Rome (Italy)). 1987. 31p. (CONF-8705150—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700997/JAW.

From International seminar on transient phenomena in multiphase flow; Belgrade, Yugoslavia (25 May 1987).

The behaviour of forced two-phase flows following inlet flow rate, pressure and power transients is presented here with reference to experiments performed with a R-12 loop. A circular duct, vertical test section (L = 2300 mm; D = 7.5 mm) instrumented with fluid (six) and wall (twelve) thermocouples has been employed. Transients have been carried out performing several values of flow decays (exponential decrease), depressurization rates (exponential decrease) and power inputs (step-wise increase). Experimental data have shown the complete inadequacy of steady-state critical heat flux correlations in predicting the onset of boiling crisis during fast transients. Data analysis for a better theoretical prediction of CHF occurrence during transient conditions has been accomplished, and design correlations for critical heat flux and time-to-crisis predictions have been proposed for the different types of transients. 17 refs.

15632 **(ENEA-RT-TERM—87-2) Influence of non condensible gas on two phase critical flow.** Celata, G.P.; Cumo, M.; D'Annibale, F.; Farello, G.E. (ENEA, Rome (Italy)). 1987. 28p. (CONF-8706259—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700998/JAW.

From European two phase flow group meeting; Trondheim, Norway (1 Jun 1987).

With reference to Loss-of-Coolant Accidents in Pressurized Water Reactors and in the frame of the wide scientific landscape of blowdown experiments aiming to the improvement of two-phase critical flows knowledge, it is of interest the analysis of non condensible gas influence on the critical flow (radiolytic gases,metal-water reactions products etc.). The present paper deals with an experiment referring to two-phase steam-water critical flows from long tubes, in which known air flowrates are injected in the stagnation region. The aim of the experiment is to detect the influence of non-condensible gas on the two-phase critical flow behaviour (critical mass flow rate, pressure and temperature profiles along the discharge channel etc.) as well as to individuate the limit, in terms of air concentration, beyond which the critical flow is affected by the presence of the gas. The employed test section is a vertical, circular duct channel with an inner diameter of 4.6 mm and a length of 1500 mm (L/D = 325). Results of initially subcooled liquid experiments (together with some data of satured liquid discharges), up to 15 bars are reported with the analysis of non-condensible effects in the different stagnation conditions. 22 refs.

15633 **(ENEA-RT-TERM—87-3) Critical heat flux phenomena in flow boiling during step wise and ramp wise power transients.** Celata, G.P.; Cumo, M.; D'Annibale, F.; Farello, G.E.; Abou Said, S. (ENEA, Rome (Italy)). 1987. 36p. (CONF-8706259—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700999/JAW.

From European two phase flow group meeting; Trondheim, Norway (1 Jun 1987).

The present paper deals with the results of an experimental investigation of the forced flow critical heat flux during power transients in a vertically heated channel. Experiments were carried out with a Refrigerant-12 loop employing a circular test section which was electrically and uniformly heated. The power transients were performed with the step-wise and ramp-wise increase of the power to the test section. The test parameters included several values of the initial power (before the transient) and the final power (at the end of the transient) in the case of step-wise transients and the slope of the ramp in the case of ramp-wise transients. The pressure and specific mass flow rate, which were kept constant during the power transient,were varied from 1.2 to 2.7 MPa and 850 to 1500 Kg/sm/sup 2/, respectively. Correlations of the experimental data for the time-to-crisis in terms of the independent parameters of the system are also proposed and verified for different values of pressure,mass flow rate, and inlet subcooling.

15634 **(N—88-12028) Helicity fluctuations and the energy cascade in turbulence. Final report.** Speziale, C.G. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Nov 1987. 13p. (NASA-CR—178403; ICASE—87-69; NAS—1.26:178403). NTIS, PC A03/MF A01.

Recent conjectures concerning the correlation between regions of high local helicity and low dissipation are examined from a rigorous theoretical standpoint based on the Navier-Stokes equations. It is proven that only the solenoidal part of the Lamb vector omega x u (which is directly tied to the nonlocal convection and stretching of vortex lines) contributes to the energy cascade in turbulence. Consequently, it is shown that regions of low dissipation can be associated with either low or high helicity, a result which disproves earlier speculations concerning this direct connection between helicity and the energy cascade. Some brief examples are given along with a discussion of the consistency of these results with the most recent computations of helicity fluctuations in incompressible turbulent flows.

15635 **(NP—8751698) On the numerical treatment of viscous flows against bodies with corners and edges by boundary element and multigrid methods.** Hebeker, F.K. (Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich 4 - Mathematik). May 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751698/JAW.

The slow viscous flow past a spatial body with corners and edges is investigated mathematically and numerically by means of a boundary element method. For the resulting algebraic system a multigrid solver is designed and analyzed. It proves to be preferable to that introduced earlier for related problems. A numerical example illustrates some of the proposed methods.

15636 **(SAND—87-1226C) Analysis of shear-layer probe data for holes in hypersonic configurations.** Bertin, J.J.; Tedeschi, W.J.; Kelly, D.P.; Bustamante, A.C.; Reece, E.W. (Sandia National Labs., Albuquerque, NM (USA); Texas Univ., Austin (USA)). 1988. Contract AC04-76DP00789. 42p. (CONF-880139—2; AIAA-Paper—88-0373). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003992/JAW.

From 26. AIAA aerospace conference; Reno, NV, USA (10 Jan 1988).

Vehicles entering the earth's atmosphere are subjected to a severe aerothermodynamic environment. If there is an opening in the surface that allows flow into the interior cavities of the reentry vehicle (RV), the complex viscous/inviscid interactions that are produced can cause increases in the aerodynamic loads and locally severe increases in heating. If a tile or a portion of a surface panel of the Space Shuttle Orbiter were to be inadvertently lost, the increased severity of the aerothermodynamic environment could jeopardize the mission of the Orbiter. In other instances, a foreign object could impact the surface of the reentry vehicle with such force as to damage the surface of the RV. Other surface openings (or ports) may be designed into reentry vehicles and proper account must be taken of the internal heating within these cavities. The effect of surface openings on the aerothermodynamic environment has been the subject of numerous investigations. A series of test programs have been conducted in Tunnel B of the Arnold Engineering Development Center (AEDC) in which wedges were exposed to the Mach 8 stream. The model design was such that one of several external surface ports, or ESPs, could be located in the wedge surface, exposing an internal cavity to the external flow. This report describes the test methods, code development and numerical analysis, and provides the experimental data obtained.

15637 **(SAND—87-1561C) Comparisons of Monte-Carlo and PNS [Parabolized Navier-Stokes] calculations for rarefied flow over reentry vehicle configurations.** Bartel, T.J.; Walker, M.A.; Homicz, G.F. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 24p. (CONF-880139—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004937/JAW.

From 26. AIAA aerospace conference; Reno, NV, USA (10 Jan 1988).

This paper compares the hypersonic flow field solutions obtained from both a kinetic and a continuum model of the rarefied flow about geometries typical of those found in aerospace applications. Experimental data, where available, are also compared to the predictions. The kinetic model used is Bird's Direct-Simulation Monte-Carlo (DSMC) algorithm. The continuum model is based on the widely-used Parabolized Navier-Stokes (PNS) equations. The configurations include a sharped cone, and spherically-blunted biconic and triconic configurations; all assume 2-D axisymmetric flow at zero angle-of-attack. The Knudsen number of the flows, based on freestream conditions, varied from approximately 10^{-3} to 1. While the comparisons with experimental data are limited to global quantities such as the drag coefficient, numerical results are also presented for surface distributions of pressure and heat transfer, and density and temperature profiles in the flow field. Difficulties encountered with both solution procedures are discussed.

15638 **(STF—15A85013) Fouling in heat exchangers.** Olsbu, A.; Berg, S.; Naess, E. (SINTEF, Trondheim (Norway)). Feb 1985. 51p. (In Norwegian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751223/JAW.

The report deals with a literature study on the deposition of foreign matters in heat exchangers. The aim of the study was to analyse the collected material in order to evaluate the possibility of verification and modification regarding the existing selection method for fouling factors. In addition the study also focuses on consequences, types of fouling, mechanisms, and models together with an evaluation of existing measuring methods and tools. The study reveal the problems by using the same method for different process conditions. The optimal fouling factors should be selected on the basis of field measurements, bench-scale experiments, cleaning routines, back-up unities, and the use of additives. 24 drawings, 2 tables, 23 references.

15639 **Comment on "Initial stages of pattern formation in Rayleigh-Benard convection".** Swift, J.B.; Hohenberg, P.C. (Department of Physics and Center for Nonlinear Dynamics, The University of Texas at Austin, Austin, Texas 78712). *Physical Review Letters;* **60**: No. 1, 75-75(4 Jan 1988).

A Comment on the Letter by C. W. Meyer, G. Ahlers, and D. S. Cannell, Phys. Rev. Lett. 59, 1577 (1987).

15640 **Interaction of pulsating and spinning waves in nonadiabatic flame propagation.** Booty, M.R.; Margolis, S.B.; Matkowsky, B.J. (Dept. of Engineering Sciences and Applied Mathematics, Northwestern Univ., Evanston, IL 60201). *SIAM Journal on Applied Mathemadics;* **47**: No. 6, 1241-1286(Dec 1987).

The authors consider nonadiabatic premixed flame propagation in a long cylindrical channel. A steadily propagating planar flame exists for heat losses below a critical value. It is stable provided that the Lewis number and the volumetric heat loss coefficient are sufficiently small. At critical values of these parameters, bifurcated states, corresponding to time-periodic pulsating cellular flames, emanate from the steadily propagating solution. The authors analyze the problem in a neighborhood of a multiple primary bifurcation point. By varying the radius of the channel, they split the multiple bifurcation point and show that various types of stable periodic and quasi-periodic pulsating flames can arise as secondary, tertiary, and quaternary bifurcations. Their analysis describes several types of spinning and pulsating flame propagation which have been experimentally observed in nonadiabatic flames, and also describes additional quasi-periodic modes of burning which have yet to be documented experimentally.

15641 **Nonlinear stability control and λ-bifurcation.** Erneux, T.; Reiss, E.L.; Magnan, J.F.; Jayakumar, P.K. (Dept. of Engineering Sciences and Applied Mathematics, Northwestern Univ., Evanston, IL 60201). *SIAM Journal on Applied Mathemadics;* **47**: No. 6, 1163-1176(Dec 1987).

Passive techniques for nonlinear stability control are presented for a model of fluidelastic instability. They employ the phenomena of λ-bifurcation and a generalization of it. λ-bifurcation occurs when a branch of flutter solutions bifurcates supercritically from a basic solution and terminates with an infinite period orbit at a branch of divergence solutions which bifurcates subcritically from the basic solution. The shape of the bifurcation diagram then resembles the greek letter λ. When the system parameters are in the range where flutter occurs by λ-bifurcation, then as the flow velocity increase the flutter amplitude also increases, but the frequencies of the oscillations decrease to zero. This diminishes the damaging effects of structural fatigue by flutter, and permits the flow speed to exceed the critical flutter speed. If generalized λ-bifurcation occurs, then there is a jump transition from the flutter states to a divergence state with a substantially smaller amplitude, when the flow speed is sufficiently larger than the critical flutter speed.

15642 **Numerical model of the flow and heat transfer in a rotating disk chemical vapor deposition reactor.** Evans, G.; Greif, R. (Computational Mechanics Division, Sandia National Laboratories, Livermore, CA 94550). *Journal of Heat Transfer;* **109**: No. 4, 928-935(Nov 1987).

Steady, laminar, axisymmetric, and circumferentially uniform flow and heat transfer, including the effects of variable properties and buoyancy, have been modeled within a rotating disk chemical vapor deposition (CVD) reactor. The reactor is oriented vertically, with the hot, isothermal, spinning disk facing upward. The Navier—Stokes and energy equations have been solved for the carrier gas helium. The solutions have been obtained over a range of parameters, which is of importance in CVD applications. The primary parameters are the ratio of the disk temperature to the free stream temperature T/sub w//T/sub ∞/, the disk Reynolds number Re = r²/sub d/ω/ν/sub ∞/, a mixed convection parameter Gr/Re/sup 3/2/ = g(rho/sub ∞/-rho/sub w/)/(rho/sub w/ ω√ων/sub ∞/), the dimensionless inlet velocity u/sub ∞//√ων/sub ∞/, and two geometric parameters r₀/r/sub d/ and L/r/sub d/. Results are obtained for the velocity and the temperature fields and for the heat flux at the surface of the rotating disk. Comparisons are made with the one-dimensional, variable-property (excluding buoyant effects), infinite rotating disk solutions of Pollard and Newman. Results are presented in terms of a local Nusselt number. The potential uniformity of CVD in this geometry can be inferred from the variation of the Nusselt number over the surface of the rotating disk. The effects of buoyancy and the finite size of the rotating disk within the cylindrical reactor are clearly evident in the present work.

15643 **Analytical and experimental study of falling-film evaporation on a horizontal tube.** Chyu, M.; Bergles, A.E. (Department of Mechanical Engineering, Texas Tech University, Lubbock, TX 79409). *Journal of Heat Transfer;* **109**: No. 4, 983-990(Nov 1987).

Heat transfer for saturated falling-film evaporation on a horizontal smooth tube has been studied through analysis and experimentation to investigate the effects of film flow rate, liquid feed height, and wall superheat. Two models have been proposed, both based on three defined heat transfer regions: the jet impingement region, the thermal developing region, and the fully developed region. The model that uses an experimental correlation for heat transfer in the fully developed region compares favorably with experimental data and other predictions reported for the case where the liquid feed is in a sheet.

15644 **Laser spectroscopic methods in flow diagnostics.** Dibble, R. (Sandia-Livermore). pp vp. of The fifth international congress on applications of lasers and electrooptics (Technical Digest). Toledo, OH; Laser Institute of America (1986). (CONF-861197—).

From ICALEO '86: laser application conference; Arlington, VA, USA (10 Nov 1986).

The measurement of a single parameter is seldom adequate for an unambiguous description of a reacting flow. Measurement of temporal and spatial variation of several parameters, such as velocity and species concentration, is typically required. In turbulent flows correlations are time dependent. Consequently, simultaneous measurement of parameters is necessary. The time resolved two dimensional image of species concentration is an obvious example of simultaneous, spatially separated, measurements of a single parameter. Less obvious, but equally valid and necessary, are the analagous time resolved "images" of different parameters such as velocity and density in flames. Several examples of these multi-parameter

images are presented. These images are generated from simultaneous measurements of various combinations of Rayleigh, Raman, fluorescence, and Mie scattering in turbulent flows.

15645 **Flow speed measurements in a supersonic free-jet expansion using a laser-induced breakdown ion time-of-flight technique.** Wantuck, P.J.; Hof, D.E. (Los Alamos National Lab., Los Alamos, NM 87545). pp vp. of The fifth international congress on applications of lasers and electrooptics (Technical Digest). Toledo, OH; Laser Institute of America (1986). (CONF-861197—).

From ICALEO '86: laser application conference; Arlington, VA, USA (10 Nov 1986).

A time-of-flight speed measurement technique utilizing ions formed in a flowing gas by the process of laser-induced breakdown (LIBTOF) is described. Breakdown is produced by focusing a pulsed, high energy laser beam in the flow. The ions are collected downstream of the breakdown volume with a suitable probe. Flow speeds are deduced from measurements of the ion flightpath distance and flight time. Because the breakdown volume is small, LIBTOF measurements can be made with a high degree of spatial resolution. This technique is used to measure flow speeds in the far-field, low density portions of a CO/sub 2/ free-jet expansion. Free-jet expansions are important mediums for low temperature molecular spectroscopy as well as sources of supersonic flow for molecular beams and other gas dynamic applications.

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REFER ALSO TO CITATION(S) 15008, 15079, 15572

15646 **(AERE-R—12319) Development of emission tomography for the nuclear industry.** Huddleston, J.; Hutchinson, I.G.; Burch, S.F.; Perring, J.K.; Davies, G. (UKAEA Atomic Energy Research Establishment, Harwell. Instrumentation and Applied Physics Div.). Nov 1986. 52p. H.M. Stationery Office, London, price Pound 6.00.

Single photon emission computed tomography (SPECT) is a relatively recent technique of non-destructive examination which was pioneered in the medical field and which is currently finding applications in the nuclear industry. The technique provides information relating to the spatial distribution of one or more radio-nuclides within an object. However, a number of problems are inherent in the technique, chiefly associated with the attenuation of radiation prior to detection. The report describes work carried out to demonstrate the technique, using both real and simulated data; problems are discussed, and routes suggested to find satisfactory solutions.

15647 **(BDX—613-3852) Material characterization and thermoforming of polyethylene terephthalate film for electrical insulation: Topical report.** Carey, D.A.; Smith, B.P. (Allied-Signal, Inc., Kansas City, MO (USA). Bendix Kansas City Div.). Dec 1987. Contract AC04-76DP00613. 21p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004488/JAW.

Differential scanning calorimetry (DSC) was used to determine as-received glass transition, crystallization, and melting temperatures of polyethylene terephthalate (PET). A Box-Behnken statistical designed experiment was used to evaluate the effect of forming temperature, forming rate, and heat-set temperature on shrinkage, tear resistance, and thermal properties. At a forming temperature of 88°C and heat-set temperature of 180°C, good-quality PET parts were produced. The optimum forming time appears to be either 0.5 min or 5.0 min. In addition, inductively coupled argon plasma emission spectroscopy (ICAP) was used to determine the catalyst system for both PET sheets from two vendors.

15648 **(DOE/ER/13218—T1) Theta pinch discharges for solids vaporization and elemental chemical analysis: Progress report, [April 15, 1987-December 1, 1987].** (Illinois Univ., Urbana (USA)). [1987]. Contract FG02-84ER13218. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004462/JAW.

The goal of this project is to develop the theta pinch discharge as a source for elemental analysis of non-volatile solid materials. The first three years of research resulted in knowledge of how to design a functioning discharge system, and of how to resolve the emission in time to optimize signal-to-background ratio. Sampling was possible on a variety of materials, but was still not sufficient for purposes of universal solids analysis. Near the end of the third year of previous research, the catastrophic failure of an insulator resulted in extensive damage to equipment which was still being repaired at the beginning of the new fiscal year.

15649 **(EGG-M—09587) Microstructure characterization with a pulsed laser ultrasonic source.** Telschow, K. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 16p. (CONF-870691—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005207/JAW.

From Review of progress in quantitative NDE; Williamsburg, VA, USA (21 Jun 1987).

Localized heating produced by absorption from a pulsed laser provides an efficient non-contacting source of ultrasonic waves in materials. This paper describes the results of experiments conducted to illustrate the feasibility of this type of source for microstructure characterization in metal and ceramic materials. Piezoelectric and capacitive wide bandwidth detection transducers have been used to record attenuation and scattering in these materials for comparison with the conventional pulse echo techniques. The laser source was found to be an efficient, versatile and wide bandwidth noncontacting source. 6 figs.

15650 **(INIS-GB—52) 3. report of the Management Advisory Committee of the Inspection Validation Centre.** (UKAEA Risley Nuclear Power Development Labs. Inspection Validation Centre). Jul 1986. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750878/JAW.

The Inspection Validation Centre (IVC) has been established at the UKAEA Risley Nuclear Power Development Laboratories for the purpose of validating procedures, equipment and personnel proposed by the CEGB for use in the ultrasonic inspection at different stages of the fabrication, erection and operation of the CEGB's proposed PWR pressure vessel and such other components as are identified by the CEGB. Technical progress since May 1985 is reported. The number of operators receiving certificates for detection and sizing of flaws is given.

15651 **(ND-R—1405-(W)) Eddy-current testing and analysis of a sample of Zircaloy fuel cladding for the OECD Halden 'Round-Robin' exercise (Phase II).** Watson, P.C.; Cross, M.T. (UKAEA Windscale Nuclear Power Development Labs.). Feb 1987. 32p. (CONF-8609347—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750329/JAW.

From Workshop meeting of the Halden Project Group; Halden, Norway (9 Sep 1986).

Two samples of Zircaloy fuel cladding were supplied, one containing pre-measured defects of known type and size, and the other containing unknown defects. Eddy-current testing techniques were used to ascertain the nature of the unknown defects. By using a high resolution encircling coil and a probe coil and then processing digitally the data with specially prepared software, nine internal defects, of volume 0.18 to 0.86 mm^3 were located positively and identified, despite interference from heavily fluctuating background signals.

15652 **(SAND—87-1095C) Acoustic wave electroless deposition monitor.** Ricco, A.J.; Martin, S.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-871027—43). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004023/JAW.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

A new type of electroless deposition monitor has been constructed from a monolithic acoustic wave device utilizing plate modes with shear displacement components. This device, which operates at 158 MHz, provides a highly accurate means of measuring mass changes (1 ng/cm^2) accompanying electrochemical reactions. The acoustic wave, in the form of a plate mode, is launched by applying a radio frequency signal to an interdigital transducer on one

face of a piezoelectric substrate. Electroless deposition is carried out on the opposite face of the quartz in the path of the wave. The acoustic plate mode, which propagates along the quartz plate to the receiving transducer, has components of displacement at the surface/electrolyte interface. Changes in mass at the quartz/electrolyte interface affect the acoustic wave velocity, which is monitored with high accuracy by utilizing the device as the feedback element of an oscillator circuit. The electroless deposition of Cu at a rate of 2 to 3 A/sec from aqueous Cu^{2+}/formaldehyde was monitored with sub-angstrom resolution. 18 refs., 6 figs.

15653 **(SAND—87-1392C) Effect of experimental variables on flash thermal diffusivity data analysis.** Sweet, J.N. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 18p. (CONF-8710249—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003631/JAW.

From 29. international thermal conductivity conference; Blacksburg, VA, USA (19 Oct 1987).

Flash thermal diffusivity data are usually analyzed with a thermal model which assumes axial heat conduction and uniform illumination of the flashed surface. For high accuracy data reduction, it becomes important to bound to the errors caused by radial heat flow and by non-uniform laser beam profiles. These effects are examined analytically for a case in which the incident laser beam is confined to a radius smaller than the sample radius. The dependence of the output of an averaging detector on the magnitude of the radial heat transfer coefficient is presented and the linear dependence of radial and axial loss sensitivity coefficients is discussed. From this discussion, we conclude that inclusion of radial loss effects in analysis of the thermal response of multilayer structures is not important unless the radial loss factor is very large. Analytical results are presetned for the temperature vs. time response of a two layer composite sample with interfacial thermal resistance and high thermal losses at the sample faces. The use of these results to reduce data for two multilayer samples is presented to show the utility of new data reduction techniques.

15654 **(UCRL—97189) Composition and thickness of multilayer foils using MeV ion-beam techniques.** Musket, R.G. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 9p. (CONF-880110—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004360/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

Characterization of both the composition and thickness of a variety of carbon and carbon-metal multilayer foils has been accomplished using simultaneous ion backscattering (RBS or BS) and particle-induced X-ray emission (PIXE). The quantitative, non-destructive measurements were made on foils with total carbon thicknesses of 96 to 460 nm and total metallic thicknesses of 14 to 260 nm. Foils with the following primary metals have been examined: titanium, chromium, nickel, copper, thorium, and uranium. The PIXE results for X-ray energies above 200 eV permitted unambiguous interpretation of the backscattering results. For the free-standing foils, the quantities and depth distributions of carbon, the primary metal, and impurities, including oxygen, were determined with a depth resolution of tens of nanometers. The foils were analyzed with either protons or helium ions. Two foils were analyzed using both protons and helium ions; the quantitative evaluations of the carbon and primary metal were, within seven percent for the carbon and three percent for the metal, independent of the probing ion. 11 refs., 6 figs., 2 tabs.

15655 **(Y/DW—751) Comparison of ultrasonic flaw detection analysis for spherical composite test specimens using two data acquisition techniques.** Brosey, W.D.; Cantrell, J.L. (Oak Ridge Y-12 Plant, TN (USA)). 19 Nov 1987. Contract AC05-84OS21400. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005002/JAW.

A study of nondestructive evaluation techniques on spherical filament wound Kevlar-epoxy test specimens has been performed at the Oak Ridge Y-12 Plant. Epoxy wetted fibers were wound on an aluminum mandrel to form the specimens. Two of the ultrasonic methods used to evaluate the specimens have been compared to determine their flaw detection capability. The first ultrasonic technique used a gated peak detector to isolate the highest signal amplitude within a preset region of the waveform. The second method consisted of digitizing the entire waveform for computerized post acquisition analysis. Seventy composite spheres containing one of seven defect conditions were inspected using both ultrasonic techniques. The defect conditions were: a no defect standard, Teflon shim simulated delaminations, low epoxy matrix, alternate winding pattern, macrosphere simulated voids, fiber tension variation, and alternate fiber. Teflon shim simulated delaminations proved to be the most detectable of the flaw types using ultrasonic analysis. Therefore, a specimen containing Teflon shim delaminations was used to demonstrate the differences in flaw finding capabilities of the two ultrasonic detection methods. The shims were placed at two depths within the composite, at half thickness and near the back surface, aluminum-mandrel interface. Data acquired using each of the techniques were displayed to obtain a map of the delaminated areas. The delamination maps were used to determine how successful each method was at locating flawed regions.

15656 **(ZfK—594, pp 22-24) Application of thin layer activation to cavitation investigations.** Eichhorn, K.; Richter, E.; Taubert, H. Jul 1987. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780042/JAW.

In Publications from the department of large-scale devices of the Central Institute of Nuclear Research at Rossendorf.

Based on experiences in thin layer activation (TLA) applied to wear measurements first tests have been made to make use of this method in investigations of cavitation effects. Essential aspects for the preparation of the tests are given. It results, TLA is advantageous in cavitation research.

15657 **Technique for impedance matching at two ultrasonic frequencies simultaneously.** Johnson, E.C. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Review of Scientific Instruments;* 59: No. 1, 188-189(Jan 1988). Contract AC02-76ER01198.

Situations arise where it would be advantageous if ultrasonic measurements could be performed at two distinct frequencies simultaneously. Such a scheme is hampered by the need for a method whereby the sample impedance at both frequencies can be matched to that of the driver electronics. Such a method is presented in this note.

15658 **Optimum angle of incidence for observing thin-film interference colors.** Muller, R.H.; Sand, M.L. (Lawrence Berkeley Laboratory, Materials & Chemical Sciences Division, Berkeley, California 94720). *Applied Optics;* 26: No. 24, 5211-5220(15 Dec 1987). Contract AC03-76SF00098.

A colorimetric analysis of white-light interference colors for transparent films on absorbing substrates has shown that specific angles of incidence exist for which the purity of interference colors is predicted to be greatest for s- or p-polarized light. These optimum angles of incidence depend primarily on the optical constants of the substrate, and they decrease from the first to the third order of interference. They provide the best conditions for the determination of film thicknesses from interference colors, and their use is essential for making interference colors visible with highly reflective substrates. As an alternate measure of the observability of interference colors, a polychromatic fringe visibility has been introduced. Its use provides similar predictions of optimum angles. The computations are in good agreement with experimental observations.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 14420, 14971, 15012, 15096, 15097, 15127, 15240, 15358, 15744, 15806, 15807, 15874

15659 (IFVE-ONF-OEA—86-5) Determination of distributed resistance of base of bipolar transistors measuring noise spectral densities. Krasnokutskij, R.N.; Kurchaninov, L.L.; Fedyakin, N.N.; Shuvalov, R.S.; Tikhonov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700197/JAW.

It is shown that the base distributed resistance r may be determined by measuring spectral noise density at the definite frequency. The parameters r for transistors GT311, GT329B, KT316D, KT355A, KT363A, KT371A, KT372A, KT382, KT3127A are determined. 17 references, 1 table.

15660 (LA—10905-MS-Pt.2) Thermal analysis of transistor packages: Part 2. Bennett, G.A.; Larkin, T.H. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005091/JAW.

Good thermal design is essential for improving the efficiency and the high-temperature capabilities of microwave power transistors. To improve thermal performance and to enhance reliability, a systematic study quantified transistor package thermal behavior. A series of two-dimensional finite element thermal analyses was completed of a transistor using several sets of boundary conditions. These analyses provide indications for the temperature field and internal thermal resistance components as a function of the imposed boundary conditions, material properties, and geometry. Results from the analyses are shown as isothermal contour plots, plots of temperature drop across the flange and carrier, and plots of temperature versus time.

15661 (LBL—22195) Ballistic deficit correction in semiconductor detector spectrometers. Goulding, F.S.; Landis, D.A. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 8p. (CONF-871006—27). NTIS, PC A02. Order Number DE88004506/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

At high energies, the energy resolution of γ-ray spectrometers using large-diameter coaxial germanium detectors can be dominated by "ballistic deficit" effects, particularly when short processing times are used to permit high rate operation. This results from the fact that rise-time variations in the detector signal are reflected in amplitude fluctuations after the signals pass through pulse shapers. The paper describes a method of compensating for these effects on a pulse by pulse basis using the fact that the loss of amplitude for slowly-rising signals is accompanied by a delay in the peak time of the shaped output signal. The simple analog corrector circuit uses a relationship whereby the amplitude deficit is roughly proportional to the square of the time delay in the peak. Results show considerable improvements in the energy resolution of germanium γ-ray spectrometers at high energies.

15662 (LBL—23286) Low-noise cryogenically cooled broad-band microwave preamplifiers. Leskovar, B. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 14p. (CONF-871072—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004561/JAW.

From Low temperature electronics symposium; Honolulu, HI, USA (18 Oct 1987).

The present noise performance, bandwidth capability and gain stability of low-noise cryogenically cooled broad-band preamplifiers are summarized and reviewed in the 150 MHz to 4 GHz frequency range. Stability factor of Gallium Arsenide Field-Effect transistors as a function of frequency and ambient temperature is presented and discussed. Also, other performance data, such as gain nonuniformity, phase shift as a function of frequency, and voltage standing-wave ratio, of several low-noise wide-band preamplifiers of interest for research instrumentation systems are presented. 10 refs., 13 figs.

15663 (LBL—23356) Ballistic deficits in pulse shaping amplifiers. Loo, B.W.; Goulding, F.S.; Gao, Dexi. (Lawrence Berkeley Lab., CA (USA); Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). Sep 1987. Contract AC03-76SF00098. 7p. (CONF-871006—24). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003908/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

This report considers the common problem of ballistic deficit which is the loss of output signal amplitude due to the interplay between the finite charge collection times in a detector and the characteristic time constants of the amplifier. Quantitative estimates of ballistic deficits have been developed by using numerical integration techniques on a microcomputer and by exact calculations using Laplace transforms. A new practical procedure has been developed in which an actual amplifier with even an unspecified complex-pole network can be accurately related to an "equivalent" semi-Gaussian shaping network whose exact solution is known. Simple formulas for estimating ballistic deficits and resulting degradation in spectral energy resolutions are given.

15664 (LBL—23817) Signal processing for an optical wide band data transmission system. Nakamura, M.; Leskovar, B.; Turko, B.T. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098;W-7405-ENG-48. 10p. (CONF-871006—33). NTIS, PC A02. Order Number DE88003854/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

The signal processing for an optical wide band transmission system using gallium arsenide (GaAs) digital integrated circuits and optical fibers has been investigated. Multiplexing, coding, synchronization, demultiplexing, and error checking at 780 MBit/s data rates are described. Data storage in memory for linking to a computer is also considered. The design uses available GaAs and silicon components. The reliability of GaAs components is discussed as well as the layout and thermal considerations required for a high speed system. 8 figs., 1 tab.

15665 (SAND—87-1547C) Radiation response of thin oxides grown by rapid thermal oxidation and rapid thermal annealing techniques. Schubert, W.K.; Seager, C.H. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-871124—48). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003632/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

High quality, 20 to 30 nm thick SiO_2 films were grown using rapid thermal oxidation techniques. Metal-oxide-semiconductor (MOS) capacitors formed with these oxides were characterized electrically using low and high frequency capacitance measurements. The effects of post oxidation annealing (POA) ambient, temperature and duration on the initial oxide properties and the radiation response of the MOS capacitors were determined. The addition of a small amount of O_2 to the POA ambient significantly reduced the radiation induced hole trapping and interface state creation, particularly for the higher POA temperatures. In addition, annealing and reirradiation experiments were carried out and showed that both the trapped charge and interface state buildup were completely reversible after anneals at 400°C. This repeatability argues against interface state creation models which involve irreversible changes in the atomic arrangements near the interface. 31 refs. 3 figs.

15666 (SAND—87-2597) An electro-optic explosive igniter. Benson, D.A.; Rose, B.H. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004728/JAW.

This report presents studies of a new concept for igniting an explosive device solely by means of an optical link with the firing system. The concept combines a new low-energy thermal igniter device, the semiconductor bridge (SCB), with new compact series photovoltaic arrays and hybrid microcircuit technology in a device to meet increased safety and security objectives. This approach pro-

vides an alternative to direct laser ignition, in increasing safety through optical coupling. We discuss the capabilities and limitations of this approach, as well as our experience with discrete component prototypes. We describe tests conducted with a variety of secondary explosives to illustrate the concept and measure the available device function times. 19 refs., 19 figs., 2 tabs.

15667 **(SAND—87-2688C) Effects of A/D conversion via interleaved sampling.** David, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-871162—4). NTIS, PC A02. Order Number DE88003003/JAW.

From 21. annual Asilomar conference on signals, systems, and computers; Pacific Grove, CA, USA (2 Nov 1987).

Time domain demultiplexing techniques are being used by a number of manufacturers in the production of high speed transient digitizers. Rather than using a single A/D converter, two or more devices are used in a cyclic arrangement. This approach enables the capture of analog signals at extremely fast composite sampling rates, while the individual A/D converters are actually operating at the lower rates which are attainable with a single A/D. This peformance is not, however, achieved without some penalty. While any real analog-to-digital conversion process results in some loss in accuracy, additional error sources are introduced by this sampling technique. In this paper, we describe several error sources and analyze the potential impact on the recorded data. Techniques for calibration and data correction are discussed. 3 refs., 4 figs.

15668 **Impedance of an annular-cathode indented-anode electron diode terminating a coaxial magnetically insulated transmission line.** Sanford, T.W.L.; Poukey, J.W.; Wright, T.P.; Bailey, J.; Heath, C.E.; Mock, R.; Spence, P.W.; Fockler, J.; Kishi, H. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* 63: No. 3, 681-688(1 Feb 1988).

The impedance of a diode having an annular cathode and indented anode that terminates a coaxial MITL (magnetically insulated transmission line) is measured and compared with a semiempirical model developed from calculations made using the m-amcapesmcapsg-smcapsIc-smcaps code. The measurements were made on the 16-Ω electron accelerator HELIA (high-energy linear induction accelerator) operating at 3 MV. The model agrees with the measurements within the 10% measuring error and shows that the diode operates in either a load- or line-dominated regime depending on AK (anode-cathode) gap spacing. In the load-dominated regime, which corresponds to small AK gaps, the diode impedance is controlled by an effective anode-cathode gap, and the flow is approximately axial. In the line-dominated regime, which corresponds to large AK gaps, the impedance is independent of the AK gap and corresponds to the impedance associated with the minimum current solution of the MITL, with the flow becoming more radial as the AK gap is increased.

15669 **Comparison between two-wire and three-wire models for shielded twisted-pair cables used in Johnson noise thermometry.** Roberts, M.J. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37831-6008). *Review of Scientific Instruments;* 59: No. 2, 298-303(Feb 1988). Contract AC05-84OR21400.

Using typical values of cable parameters and typical connections used in Johnson noise thermometry, a comparison was made between a two-wire and a three-wire transmission line model of a 30-m-long, shielded, twisted-pair cable over a range of frequencies from 0 to 300 kHz. For a 200-Ω source impedance and a 1-MΩ load impedance, the maximum difference between the voltage transfer functions calculated from the two models was 0.415%. For a 500-Ω source impedance, the maximum difference was 0.607%. For a 200-Ω source impedance and a 1-Ω load impedance, the maximum difference between the current transfer functions calculated from the two models was 4.24%. For a 500-Ω source impedance, the maximum difference was approximately 4.47%.

15670 **Magnetically insulated transmission line oscillator.** Clark, M.C.; Marder, B.M.; Bacon, L.D. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* 52: No. 1, 78-80(4 Jan 1988). Contract AC04-76DP00789.

The magnetically insulated transmission line oscillator (MILO) is a concept for producing very high-power microwave pulses. It is based on the relativistic flow of electrons in a magnetically insulated transmission line on which a slow wave structure, typically thin metal vanes, has been imposed. Its geometry is similar to that of a linear magnetron or crossed-field amplifier. In the MILO, however, the magnetic field which insulates the diode is produced by the electron flow itself rather than being imposed by external coils. This eliminates the need to match the applied voltage to the magnetic field. Because both the insulating magnetic field and accelerating voltage are produced by the same source, the device can be run at high voltages without electrical breakdown.

15671 **Semiconductor industry and the national laboratories: part of a national strategy.** Washington, DC; National Academy Press (1987). 44p. National Academy Press, National Research Council, 2101 Constitution Ave., N.W., Washington, DC 20418.

Report of a workshop, National Research Council, Feb. 24, 1987.

To facilitate greater cooperation between the national laboratories and the semiconductor industry, several suggestions were made. (1) A dialogue between the semiconductor industry and the national laboratories should be initiated and formalized to identify appropriate research projects and to negotiate pragmatic solutions to issues like data access, ownership and publication rights, cost sharing, scheduling, and technology transfer mechanisms. (2) A standing advisory council with representatives from industry and the various national laboratories could be formed to facilitate this dialogue and to serve as a forum for the discussion of issues. Such a council could develop a broad agreement on the generic issues involved in cooperation and coordinate the overall cooperative effort. (3) There are opportunities for the national laboratories to continue existing projects and to initiate new research that would be beneficial to the industry. However, to maximize the effectiveness of this research, the mission of the laboratories needs to be expanded to include research in semiconductor-related science and technology. Additional funding will also be needed to provide the laboratories with sufficient resources to make an effective contribution to the long-term competitiveness of the semiconductor industry. There was broad agreement at the workshop that the federal government in general, and the national laboratories in particular, have a role to play in restoring US competitiveness in semiconductors.

15672 **Two-lens, anamorphic, Brewster-angle, fourier-transform relay.** Berggren, R.R. (Chemical and Laser Sciences Div., Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). pp 180-184 of Present trends in optical systems design: Computer lens design workshop. Londono, C.; Fischer, R.E. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870132—).

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

A two-lens system provides a simple and versatile means to relay a laser beam. The pair of lenses can provide true volume imaging, reproducing both amplitude and phase of the input beam. By using cylindrical lenses it is possible to change the aspect ratio of the beam. By adjusting the cylindrical curvatures, it is possible to minimize reflections by tilting the lenses at the Brewster angle.

15673 **HIMASS electromagnetic launcher at Los Alamos.** Zimmerman, E.L.; Fowler, C.M.; Foley, E.; Parker, J.V. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG-22: No. 6, 1823(Nov 1986).

The HIMASS electromagnetic launcher is a unique large-bore, large-mass railgun driven by a helical flux compression generator. Two experiments were conducted at 3-4 MA current levels. The objective of the experiments was to study the effects of scaling, ablation, and material parameters on electromagnetic launcher performance. Data from these two experiments are presented.

15674 **A launcher barrel for the lethality test system railgun.** Sims, J.R.; Christensen, K.E.; Cummings, C.E.; Calkins, N.C. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG-22: No. 6, 1742(Nov 1986).

A reusable plasma armature railgun barrel design is described. This barrel was designed and is being fabricated at the Los Alamos National Laboratory for use in a kinetic energy lethality test system. The performance goals for this barrel are (1) that it be able to withstand the loads generated when accelerating a 30-g projectile to a velocity of 15 km/s without sustaining permanent damage, (2) that it have multiple shot capability, and (3) that it be capable of being repaired and/or modified. The barrel design and features are described.

15675 **Numerical predictions of railgun performance including the effects of ablation and arc drag.** Schnurr, N.M.; Kerrisk, J.F.; Parker, J.V. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG-22: No. 6, 1733-1741(Nov 1986).

Thermal radiation from plasma armatures in railguns may cause vaporization and partial ionization of the rail and insulator materials. This causes an increase in mass of the arc, which has an adverse effect on projectile velocity. Viscous drag on the arc also has a deleterious effect, particularly at high velocities. Simulations were performed and numerical results were compared with experimental data for a wide range of test performed at the Los Alamos and Lawrence Livermore National Laboratories, the Ling Temco Vought Aerospace and Defense Company, and the Center for Electromechanics at the University of Texas at Austin. The effects of ablation and arc drag on railgun performance are discussed. Some strategies for reducing the effects of ablation are proposed.

15676 **Technology of thermal hypervelocity launchers.** Powell, J.R.; Horn, F.L.; Benenati, R.; Lowrey, A. (Brookhaven National Lab., Upton, NY 11973). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG-22: No. 6, 1675(Nov 1986). Contract AC02-76CH00016.

A new type of hypervelocity launcher is described, the Thermal Hypervelocity Launcher (THL). The THL uses stored thermal energy in a compact, lightweight particle bed heater to rapidly (milliseconds) heat a high pressure low molecular weight propellant (hydrogen or helium). The hot propellant then expands in a conventional barrel accelerating the projectile. The THL can achieve velocities up to — 12 km/sec. The technology of the THL is described, including experiments on thermal-hydraulics of particle bed heaters. An experiment to demonstrate THL operation with 100 gram projectiles at 3 km/sec is being attempted.

15677 **Experimental measurement of ablation effects in plasma armature railguns.** Parker, J.V.; Parsons, W.M. (Los Alamos National Lab., Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG-22: No. 6, 1633-1640(Nov 1986).

Experimental evidence supporting the importance of ablation in plasma armature railguns is presented. Experiments conducted using the HYVAX and MIDI-2 railguns are described. Several indirect effects of ablation are identified from the experimental results. An improved ablation model of plasma armature dynamics is proposed which incorporates the restrike process.

15678 **Railgun conductor heating from multiple current pulses.** Kerrisk, J.F. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG-22: No. 6, 1561(Nov 1986).

A numerical technique for solving current- and thermal-diffusion problems in railgun conductors has been used to study joule heating in rails that are subject to multiple current pulses. Copper rails that are 25 mm high by 12.5 m wide with a 20-mm-square bore and a current pulse with 1-MA peak current and 1-ms pulse width at half maximum were assumed. This combination of parameters is sufficient to accelerate an 80-g projectile to 2-3 km/s with each current pulse. Three parameters were varied in the analysis: the repetition rate or current pulse frequency (3.3 to 100 Hz), the coolant heat-transfer coefficient (5 x 10/sup 4/ and 5 x 10/sup 5/ W/m/sup 2/ . K), and the coolant channel distribution in the rail. Detailed results are used to illustrate the acceptability or unacceptability of particular combinations of these parameters for operation at steady state.

15679 **Superconducting augmented rail gun (SARG).** Homan, C.G.; Cummings, C.E.; Fowler, C.M. (U.S. Army Armament Research and Development Center, Watervliet, NY 12189-4050). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG-22: No. 6, 1527-1557(Nov 1986).

Superconducting augmentation consists of a superconducting coil operating in the persistent mode closely coupled magnetically with a normally conducting rail gun. A theoretical investigation of the effect of this system on a rail gun has shown that two benefits occur. Projectile velocities and launch efficiencies increase significantly depending on the magnetic coupling between the rail and augmentation circuits. Previous work evaluated an idealized system by neglecting energy dissipation effects. In this paper, the authors extend the analysis to include the neglected terms and show improved actual launch efficiencies for the SARG configuration. In this paper, the authors discuss details of projectile design in depth and present preliminary results of rail gun performance.

15680 **Summary of EM launcher experiments performed at LLNL.** Hawke, R.S.; Nellis, W.J.; Newman, G.H.; Rego, J.; Susoeff, A.R. (Lawrence Livermore National Lab.). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG-22: No. 6, 1510-1526(Nov 1986). Contract W-7405-ENG-48.

Performance results for three railguns are summarized. The system used a helium gas-driven injector and railgun launcher to accelerate 1- and 4-g polycarbonate projectiles intact up to 6.6 and 3.0 km/s, respectively. A 625 kJ capacitor bank powered the railgun, and an adjustable inductor provided pulsed shaping and peak current control. Operation in hard and soft vacuum was reliably achieved. The diagnostic system measured the projectile position and launch velocity, verified that the projectile was launched intact in the desired direction, and identified system components where improvements could enhance performance. The system performed as expected up to 4-5 km/s but below expectations at higher velocities. Estimates of ablated launcher mass, drag forces, methods of eliminating restrike, and suggestions for improving the performance of railguns are discussed.

15681 **Railguns powered by explosive driven flux compression generators.** Fowler, C.M.; Zimmermann, E.L.; Cummings, C.E.; Davidson, R.F.; Foley, E.; Hawke, R.S.; Kerrisk, J.F.; Parker, J.V.; Parsons, W.M.; Peterson, D.R. (Los Alamos National Lab., Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG-22: No. 6, 1475-1502(Nov 1986).

Explosive driven flux compression generators (FCG's) are single-shot devices that convert part of the energy of high explosives into electromagnetic energy. Some classes of these generators have served quite well as railgun power sources. In this paper and the following paper the authors describe strip and helical type FCG's, both of which are in use in the Los Alamos railgun program. Advantages and disadvantages these generators have for railgun power supplies are discussed, together with experimental results obtained and some of the diagnostics found particularly useful.

15682 **Predicting bore deformations and launcher stresses in railguns.** Davidson, R.F.; Cook, W.A.; Rabern, D.A.; Schnurr, N.M. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG-22: No. 6, 1435-1440(Nov 1986).

The structural responses of launchers are important because they affect the projectile performance and the operating limits of the railgun system. Structural analysis makes it possible to make better decisions in launcher design. Example analyses of the Los

Alamos HIMASS and Lethality Test System launchers are presented in this paper. Also, a discussion of the benefits and limitations of these analyses is included.

15683 **The lethality test system.** Parsons, W.M.; Sims, J.R.; Parker, J.V. (Los Alamos National Lab., Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG-22: No. 6, 1641-1644(Nov 1986).

The Lethality Test System (LTS), presently under construction at Los Alamos, is an electromagnetic launcher facility designed to perform impact experiments at velocities up to 15 km/s. The launcher is a 25 mm round bore, plasma armature railgun extending 22 m in length. Preinjection is accomplished with a two-stage light gas gun capable of 7 km/s. The railgun power supply utilized traction motors, vacuum interrupters, and pulse transformers. The design of these traction motors, vacuum interrupters and pulse transformers are detailed.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 14382, 14876

15684 **(CONF-871038—5) The depletion of aqueous nitrous acid in packed towers.** Counce, R.M.; Crawford, D.B. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Chemical Engineering). 1987. Contract AC05-84OR21400. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002315/JAW.

From 5. symposium on separation science and technology for energy application; Knoxville, TN, USA (26 Oct 1987).

The depletion of aqueous nitrous acid was studied at 298°K and at slightly greater than atmospheric pressure. Solutions containing nitrous and nitric acids were contacted with nitrogen in towers packed with 6- and 13-mm Intalox saddles. The results indicate the existence of two depletion mechanisms for the conditions studied - liquid-phase decomposition and direct desorption of nitrous acid. Models based on mass-transfer and chemical-kinetic information are presented to explain the experimental results. 24 refs., 8 figs., 3 tabs.

15685 **(DOE/BP/15108—1) Design and application of an advanced industrial waste-to-energy Rankine-Cycle Power System: Final report.** (Mechanical Technology, Inc., Latham, NY (USA)). Oct 1986. Contract AC79-84BP15108. 626p. NTIS, PC A99. Order Number DE88002663/JAW.

The advanced, industrial, waste-to-energy, Rankine-cycle system was designed to convert wood processing residue, a renewable resource, to electrical energy and steam. The system consists of an advanced tube-in-bed, fluidized-bed boiler, designed to burn a wide variety of wood wastes, combined with a high efficiency, radial-inflow, back pressure steam turbine. The turbine drives a generator to supply electrical power for the mill while the exhaust steam is utilized for process requirements such as driers. This report consists of the following tasks: investigation of environmental effects and their mitigation; and development of an investment figure of merit, based on a comprehensive life-cycle costing analysis, by which to quantify the techno-economic merit of Rankine-cycle system; identification of potential demonstration sites based on the criteria developed in Task 1; preliminary design of the complete advanced Rankine-cycle system, including boiler, turbine, and principal ancillary items, and development of economic scenarios for the system, based on the economic analysis methods developed earlier; development of a site screening matrix for 25 potential installation sites, based on the procedures developed in Task 2 and augmented by extensive discussions with mill operators; and determination of the specific set of terms and conditions on which at least one potential investor would be prepared to invest.

15686 **(NYSERDA—87-16-Vol.1) Results of the combustion and emissions research project at the Vicon Incinerator Facility in Pittsfield, Massachusetts: Final report, Volume 1.** (Midwest Research Inst., Kansas City, MO (USA)). Jun 1987. 218p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88004342/JAW.

The New York State Energy Research Development Authority (Energy Authority) contracted with Midwest Research Institute (MRI) to conduct a series of tests at the Municipal Solid Waste incineration facility operated by VICON Recovery Associates in Pittsfield, Massaschusetts. The project was conducted in two phases. This final report presents the results of Phase II. Phase II was directed to the monitoring of combustion variables and to the sampling and analysis of polychlorinated dibenzo-p-dioxins, polychlorianted dibenzofurans, polychlorinated biphenyls, chlorobenzenes, chlorophenols, and polynuclear aromatic hydrocarbons in the combustion gases. Tests were conducted under several different incinerator operating conditions, including with different waste feeds, to identify any relationships between those compounds and the combustion variables and operating conditions.

15687 **(NYSERDA—87-16-Vol.4) Results of the combustion and emissions research project at the Vicon Incinerator Facility in Pittsfield, Massachusetts: Final report, Volume 4 (Appendices L-O).** (Midwest Research Inst., Kansas City, MO (USA)). Jun 1987. 269p. NTIS, PC A12. Order Number DE88004339/JAW.

The New York State Energy Research Development Authority (Energy Authority) contracted with Midwest Research Institute (MRI) to conduct a series of tests at the Municipal Solid Waste incineration facility operated by VICON Recovery Associates in Pittsfield, Massachusetts. The project was conducted in two phases. This final report presents the results of Phase 2. Phase 2 was directed to the monitoring of combustion variables and to the sampling and analysis of polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, polychlorinated biphenyls, chlorobenzenes, chlorophenols, and polynuclear aromatic hydrocarbons in the combustion gases. Tests were conducted under several different incinerator operating conditions, including with different waste feeds, to identify any relationships between those compounds and the combustion variables and operating conditions. Time frequency plots for selected operating parameters are given as well as statistical percent analysis for stack gas and combustion parameters. Statistical procedures and Phase 1 data are summarized.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 14870

15688 **(N—88-12539) Two-dimensional finite difference program for thermal analysis of rocket thrust chambers.** Naraghi, M.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1987. 53p. (NASA-TM—100191; E—3773; NAS—1.15:100191). NTIS, PC A04/MF A01.

A two-dimensional finite difference computer model for thermal analysis of rocket thrust chambers has been developed. The model uses an iterative scheme for calculating the temperature distribution within the chamber wall and implements a successive overrelaxation formula for a quick convergence. The inputs of the models are the dimensions of the thrust chamber wall, types of materials used, heat transfer coefficients and temperatures of the hot gas and the coolant. The resulting output of the program consists of the nodal temperature distribution, heat transfer to the coolant and heat transfer from the hot gas.

15689 **Efficiency of a combustion reaction in power production.** Schell, M.; Schram, H.M.; Ross, J. (Department of Chemistry, Southern Methodist University, Dallas, Texas 75275). *Journal of Chemical Physics;* 88: No. 4, 2730-2734(15 Feb 1988).

We analyze a thermal engine in which the source of heat is the combustion reaction $CH_4+2O_2 \rightarrow CO_2+2H_2O$. The efficiency of the thermal engine is defined as the ratio of the power output of the engine to the power input. We compare the efficiency in two modes of operation, one in which the input and output of chemical species are constants and one in which their corresponding fluxes have an imposed oscillatory component of a given amplitude and frequency. The ratio of efficiency in the oscillatory mode to the stationary flux mode can be as high as 1.3 for an amplitude of variation of the input and output fluxes plus or minus 40% of the stationary value. At low amplitudes of variation (10%), a single peak is present in a plot of the ratio of efficiency vs frequency of the

fluxes. For higher amplitudes there are two peaks in that plot. One peak is associated with a response of the system that has the same period as the fluxes and the other occurs in a frequency range for which the periodic response is twice that of the perturbation. We calculate plots of the oscillatory output flux and the power output divided by that flux, which is an analog of a thermodynamic force, as a function of time, to show the importance of both resonance effects and the phase relation between the flux and the thermodynamic force in determining the ratio of efficiency.

15090 **Equilibrium temperature profiles in highly sensitive tubular reactors.** Hagan, P.S.; Herskowitz, M.; Pirkle, C. (Los Alamos National Lab., Los Alamos, NM 87545). *SIAM Journal on Applied Mathemadics;* 47: No. 6, 1287-1305(Dec 1987).

The authors consider a highly exothermic reaction being carried out in a long tubular fixed-bed reactor, whose walls are maintained at a fixed temperature T/sub c/ by external cooling. To maintain control of these reactions and avoid reactor runaways, such reactors must be designed so that their temperature rises ΔT are small fractions of the adiabatic temperature rise ΔT/sub ad/, the rise which would occur if the reactor was insulated. However, ΔT/ΔT/sub ad/ << 1 can only occur if eta identical to t/sub dif// t/sub reac/ << 1, where t/sub dif/ is the timescale on which heat escapes the reactor by diffusing radially to the cool reactor walls and t/sub reac/ is the reaction timescale. Here they exploit eta << 1 to reduce the reactor equations to T/sub s/ = delta/sup 2/T + QR(X, T), 0<r<1, -T/sub r/ = γ(T - T/sub c/) at r = 1, in two space dimension r, θ. After showing that all steady solutions depending on θ are unstable, they construct the bifurcation diagram for the radially-symmetric steady solutions, using T/sub c/ as the bifurcation parameter. They find that the only bifurcation points are turning points. They then analyze the stability and domains-of-attraction of these symmetric steady solutions. They discover that only the bottom solution branch represents practical operating states for the reactor: all other steady solutions are either unstable or occur at unreasonably high temperatures. Finally, the domain-of-attraction results enable us to conclude that the reactor will operate stably according to the bottom branch of solutions if T/sub c/ < T/sub c//sup cr/, and that reactor runaway occurs if T/sub c/ > T/sub c//sup cr/ where T/sub c//sup cr/ is the turning point of the bottom solution branch.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 14008, 16280, 16281

15091 **(NAGRA-NTB—86-09) Exploration borehole Kaisten. Building and environmental aspects, drilling technology.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Feb 1986. 106p. (In German). Nagra, CH-5401 Baden, Switzerland.

The exploration well at Kaisten was realized as the fifth well within the Nagra Deep Drilling Program in Northern Switzerland. The drilling work was started February 13, 1984. Having reached the final depth of 1305.8 m on June 27, 1984, the test phase was initiated and completed by May 3, 1985. The well drilled approx. 300 m of sediments and approx. 1000 m of crystalline rock. Oriented cores were taken over the whole length of the well. The present report presents the drilling activities, civil construction work related to the site and precautions taken to account for environmental protection aspects. A chapter dealing with the commission representing members of the federal, cantonal and local authorities and about reporting is given at the end of this report.

4230 Marine Engineering

15092 **(DTH-ISVA-Series Pap.—40) Two-phase flow in pipelines and risers.** Asp Hansen, E. (Danmarks Tekniske Hoejskole, Lyngby. Inst. for Stroemningsmekanik og Vandbygning). Aug 1986. 113p. NTIS (US Sales Only), PC A06. Order Number DE88751142/JAW.

The subject of this report is simultaneous gas-liquid flow in pipes. Flow in horizontal and near horizontal pipes is discussed. A model is developed for predicting liquid hold-up and pressure drop in stratified flow. The model is plane and makes use of a methodology developed by Engelund (1973). Approximation formulas are written, so the model also can be used for circular pipes. The model is verified with measurements. The stability of the interface between gas and liquid in stratified flow is examined by use of the Kelvin-Helmholtz model, which only involves gravity, inertia forces and surface tension. It is concluded that the viscous effects and the velocity profiles in the gas and liquid for most purposes must have an influence on the wave generation. Based on the velocity profiles calculated previously a model is developed taking these viscous effects into account. In the model, the slip-velocity concept is utilized, and the Orr-Sommerfeld equation is solved. The model is constructed after the same principle as the one of Larnaes (1976), who investigated generation of wind-waves. The model is verified with measurements in circular pipes. The wave height across the flow in circular pipes is examined. It is concluded that this variation is moderate. In the two last chapters slug flow in vertical pipes is dealt with. The shape and rising velocity of slugs in still liquid are calculated. The model, which is verified by experiments, makes use of potential theory. The effect on the rising velocity from the velocity profile in a flowing liquid is explained. Finally an explanation is given of the factor which determines the frequencies of the slugs, and the transition from slug flow to annular flow. A criterium is developed for the on-setting of severe slugging in a depth point between a near horizontal pipe and a vertical riser. This model is also verified by experiments. (EG). 30 refs.

15093 **(STF—71A86008) Nonlinear dynamic response of a deep water jacket platform.** Syvertsen, K.; Loeseth, R. (SINTEF, Trondheim (Norway)). Oct 1986. 135p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751192/JAW.

This report includes a discussion of a numerical investigation of response due to nonlinear wave loading. In the study a fixed steel platform has been used as example platform. The example platform is placed in 340 m water depth. Its fundamental eigenperiods are in the range of 3 to 6 s. The analyses presented are based on computer analysis solving the dynamic equation of motion in the time domain. Nonlinear effects related to the wave load process are studied. Significant influence on the estimated extreme response is found from nonlinearities due to drag forces and from current influence. The use of a Gaussian model (Rayleigh distribution) will give non-conservative results. 8 refs., 71 figs., 30 tabs.

15094 **(STF—71A86040) FAROW. A computer program for dynamic response analysis and fatigue life estimation of offshore structures exposed to ocean waves.** Olufsen, A.; Farnes, K.A.; Fergestad, D. (SINTEF, Trondheim (Norway)). Jun 1986. 73p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751132/JAW.

The theoretical aspects of the computer program FAROW are outlined. The program, which aims primarily at fixed offshore platforms includes the following main types of analysis: 1. Static response analysis 2. Analysis of quasistatic response due to wave loads 3. Free vibration analysis 4. Earthquake analysis 5. Computation of transfer functions for stochastic wave loading 6. Statistical analysis of response 7. Estimation of fatigue damage. This theoretical manual is based upon an earlier edition of FAROW theoretical manual. 15 drawings, 31 references.

15095 **(STF—71A86055) LOSFAR. A computer program for long term statistical response and fatigue analysis of marine structures. Users manual.** Syvertsen, K., Farnes, K.A. (SINTEF, Trondheim (Norway)). Sep 1986. 60p. NTIS (US Sales Only), PC A04. Order Number DE88751131/JAW.

The theoretical aspects of the computer program LOSFAR are outlined and a description of the input to the program is given. The program combines linear transfer functions and wave data and calculates: 1. Short term statistics of waves and response. 2. Long term statistics of waves and response. 3. Fatigue damage calculations and fatigue estimation. 1 drawing.

15696 **(STF—71A86084) Fatigue of large scale plate girders. Final report.** Eide, O.I.; Berge, S. (Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)). Dec 1986. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751114/JAW.

Large-scale welded girders with plate thickness 20, 40 and 60 mm were tested in four point bending. Residual stresses, weld-induced distortions, and secondary stresses were measured. Block program loading was applied, with a stress spectrum resembling wave loading on offshore structures. Fatigue crack initiation and growth at transverse stiffeners were measured and fatigue lives compared with design codes as well as with fracture mechanics computations. The effect of plate thickness was investigated. 17 refs., 27 figs.,4 tabs.

15697 **(VTT-TUTK—472) Propeller as a sound source and prediction methods of structure-borne sound in ships.** Hynnae, P. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Mar 1987. 134p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751106/JAW.

The publication presents a literature survey concerning ship's propeller as a sound source and prediction methods of structure-orne sound transmission as well as a description of the SEA-program developed based on the statistical energy analysis. Concerning the source strength of propeller semi-empirical methods and a theoretical model are presented. The theoretical model can be used to make predictions up to frequency 240 f/sub 0/, where f/sub 0/ is the rotational speed of the propeller. In addition a model of the response of hull plates to the propeller excitation is presented. As to prediction methods of structure-borne sound transmission both semi-empirical and analytical methods are dealt with. Semi-empirical methods can be considered as a set of model rules able to transform the acoustics of previous ships into that of similar future ones. They are not able to predict the effects of structural changes. Of the analytical methods the wave guide model describes the structure-borne sound transmission in a vertical section of a ship structure between two frames. In the SEA-technique the ship structure is divided along natural boundaries to subsystems coupled together. The use of the SEA-technique has been restricted by the great amount of work needed to prepare the input data. In the SEA-program developed the same principles are used as in the programs based on the finite element method to describe the steel structure, i.e. the structure is described with nodes and elements. This makes possible the description of the geometry of the ship and calculation of the couplings by computer, which decreases the amount of work needed to prepare the input data. The validity of the program developed has been checked when making sound pressure level calculations for a test vessel.

4240 Pollution Control Equipment

15698 (CONF-8703206—, pp 144-165) **Process technology in keeping the air clean - new aims and new methods.** Brauer, H. (Technische Univ. Berlin, Germany, F.R. Inst. fuer Chemieingenieurtechnik). 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751688/JAW.

From 30. anniversary of the VDI Commission on air pollution prevention; Duesseldorf, F.R. Germany (17 Mar 1987).

Schriftenreihe der VDI-Kommission Reinhaltung der Luft.; v. 6.

The emission of harmful substances and carriers from production plants must be lowered far below the limits, which are now laid down in laws and management regulations. This extensive reduction of emission requires permanent interventions in the production process at every stage. Further, improvements or new developments must be introduced in equipment technique, particularly for the cleaning stage. The target which appears to be very far away at present, must be the production plant without emission, or, as an intermediate solution, with low emission. The technical problems to be derived from this target can be solved most successfully by the process engineer, whose method of operation is orientated towards emission.

4250 Power Cycles

REFER ALSO TO CITATION(S) 15629

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 16205, 16223

15699 **(LA—11130-C) Proceedings of the international workshop on hadron facility technology .** Thiessen, H.A. (comp.). (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 591p. (CONF-870260—). NTIS, PC A25/MF A01; 1; GPO Dep. Order Number DE88004741/JAW.

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The conference included papers on facility plans, beam dynamics, accelerator hardware, and experimental facilities. Individual abstracts were prepared for 43 papers in the conference proceedings. (LEW)

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 15794, 16558

15700 **(BNL—40531) The AGS complex as an antiproton filling station.** Lee, Y.Y.; Lowenstein, D.I. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-8710125—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004440/JAW.

From 2. review and planning workshop on antiproton science and technology; Santa Monica, CA, USA (6 Oct 1987).

A transportable antiproton storage device to store and transport low energy antiprotons for use away from the production facility has been proposed previously. In this note the AGS complex is examined as a possible filling station for such a device. The production and collection rate of antiprotons is discussed, and a possible scenario is offered for the antiproton collection and deceleration cycle. (LEW)

15701 **(BNL—40566) Model-based accelerator controls: What, why and how.** Sidhu, S.S. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 3p. (CONF-8708145—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005032/JAW.

From Workshop on model based accelerator controls; Upton, NY, USA (16 Aug 1987).

Model-based control is defined as a gamut of techniques whose aim is to improve the reliability of an accelerator and enhance the capabilities of the operator, and therefore of the whole control system. The aim of model-based control is seen as gradually moving the function of model-reference from the operator to the computer. The role of the operator in accelerator control and the need for and application of model-based control are briefly summarized. (LEW)

15702 **(BNL—40574) Large amounts of antiproton production by heavy ion collision.** Takahashi, Hiroshi; Powell, J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 40p. (CONF-8710125—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004860/JAW.

From 2. review and planning workshop on antiproton science and technology; Santa Monica, CA, USA (6 Oct 1987).

To produce large amounts of antiprotons, on the order of several grams/year, use of machines to produce nuclear collisions are studied. These can be of either proton-proton, proton-nucleus and nucleus-nucleus in nature. To achieve high luminosity colliding beams, on the order of 10^{41} m/cm^3, a self-colliding machine is required, rather than a conventional circular colliding type. The self-colliding machine can produce additional antiprotons through successive collisions of secondary particles, such as spectator nucleons. A key problem is how to collect the produced antiprotons without

capture by beam nuclei in the collision zone. Production costs for anti-matter are projected for various energy source options and technology levels. Dedicated facilities using heavy ion collisions could produce antiproton at substantially less than 1 million $/milligram. With co-production of other valuable products, e.g., nuclear fuel for power reactors, antiproton costs could be reduced to even lower values.

15703 **(BNL—40591) Model based controls and the AGS booster controls system architecture.** Casella, R.A. (Brookhaven National Lab., Upton, NY (USA)). 18 Aug 1987. Contract AC02-76CH00016. 2p. (CONF-8708145—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004866/JAW.

From Workshop on model based accelerator controls; Upton, NY, USA (16 Aug 1987).

The Heavy Ion Transfer Line used to inject heavy ions created at the Tandem Van de Graaff into the Alternating Gradient Synchrotron (AGS) is briefly discussed, particularly as regards its control system. (LEW)

15704 **(BNL—40592) The representation of knowledge within model-based control systems.** Weygand, D.P.; Koul, R. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 11p. (CONF-8708145—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004863/JAW.

From Workshop on model based accelerator controls; Upton, NY, USA (16 Aug 1987).

Representation of knowledge in artificially intelligent systems is discussed. Types of knowledge that might need to be represented in AI systems are listed, and include knowledge about objects, events, knowledge about how to do things, and knowledge about what human beings know (meta-knowledge). The use of knowledge in AI systems is discussed in terms of acquiring and retrieving knowledge and reasoning about known facts. Different kinds of reasonings or representations are ghen described with some examples given. These include formal reasoning or logical representation, which is related to mathematical logic, production systems, which are based on the idea of condition-action pairs (production), procedural reasoning, which uses pre-formed plans to solve problems, frames, which provide a structure for representing knowledge in an organized manner, direct analogical representations, which represent knowledge in such a manner that permits some observation without deduction. (LEW)

15705 **(CEA-CONF—9022) ALS supra project. Highlights of scientific program.** Gerard, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Apr 1987. 3p. (CEA-DPH-N-S—2457B; CONF-8703136—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751337/JAW.

From Elementary structure of materials; Les Houches, France (24 Mar 1987).

Published in summary form only.

15706 **(CONF-8709217—2) Status of the 25URC accelerator.** Ziegler, N.F.; Mills, G.D.; Meigs, M.J.; McPherson, R.L.; Juras, R.C.; Jones, C.M.; Haynes, D.L.; Alton, G.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003778/JAW.

From SNEAP conference; Tallahassee, FL, USA (27 Sep 1987).

This paper discusses the operation of the 25URC accelerator. Shaft and charging chain life, new corona point holder, recirculating gas stripper, an air-SF_6 separator, and replication of chopped beam pulse are discussed. Seven new ion species were provided for experiment. 2 refs., 2 figs., 2 tabs. (LSP)

15707 **(CRN-VIV—34) Vivitron: progress report 1986.** (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1987. 74p. (In French and English). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751379/JAW.

The construction of the VIVITRON, an electrostatic tandem accelerator of 35 MV has started in February 1986. The different steps in the evolution of the project are illustrated by the figures included in the present report: tests of a VIV section and of the insulators in the CN accelerator, computer assisted conception of the mechanical structure, construction of the VIV building and tank installation. During 1986, development work has been performed on the VIV post spacers, on the composite material used in the column structure, on the belt charging system and on specific items connected with the VIV beam: injector and charge state selector. The VIV group has the chance to receive advice from a Technical Committee composed of accelerator experts from french Laboratories and also from Daresbury , Heidelberg and Muenich. The committee meets three times per year and we have included in the report the minutes of the 1986 meetings. They contain all the information concerning the budget and the schedule of the project. It is expected that after completion of the building and the tank, the mounting of the VIV generator will start in June 1987.

15708 **(EFI—877(28)-86) Influence of the frequency of electron passage through a thin target on the uniformity of gamma radiation yield in a quickcycling synchrotron.** Zapol'skij, N.A.; Simonyan, Kh.A.; Taroyan, S.P.; Tumanyan, A.R.; Apkar'yants, P.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700152/JAW.

The influence of the frequency of electron passage through various in-set targets on the uniformity of gamma radiation yield is investigated in cyclic accelerator and the experimental results are reported. Reasons for photon yield uniformity deterioration and incomplete utilization of accelerated electron beam intensity on in-set thin targets are discussed. Some practical recommendations are given. 5 references, 3 figures.

15709 **(EFI—878(29)-86) Influence of the number of radial betatron oscillations of accelerated electrons on the angular spread of bremsstrahlung from synchrotron internal targets.** Zapol'skij, N.A.; Markar'yan, A.A.; Simonyan, Kh.A.; Taroyan, S.P.; Tumanyan, A.R.; Apkar'yants, P.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700153/JAW.

The dependence of angular spread of photon beams emitted from synchrotron internal targets, on a number of radial betatron oscillation of accelerated electrons and characteristics of targets being used is reported and the results of experimental investigations are discussed. 6 references, 6 figures.

15710 **(EFI—912(63)-86) Calculation of operation modes of the Erevan synchrotron systems at increased acceleration cycles.** Martirosyan, G.A.; Nikogosyan, V.Ts.; Oganesyan, S.N.; Petrova, A.A.; Sadoyan, K.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700168/JAW.

A posibility of acceleration cycles frequency increase without basic changes in available systems has been investigated. The accelerating and magnet systems have been studied, their parameters having been compared at two values of accelerating frequency, namely 47 and 62.5 Hz. It is shown, that at the 62.5 Hz frequency the accelerated beam mean current increases by 33% without any increase in high-frequency power consumption without changes in the energy spread of extracted beam. In this operation mode a capacity of condenser battery of electromagnet resonance circuit is reduced by half, while increase in electromagnet active losses does not exceed values permissible for the magnet system available. Operation at increased frequency of acceleration cycles is an initial stage of converting the synchrotron to he flat-top operation mode. 5 references, 3 figures.

15711 **(FNAL/C—87/160) A practical guide to modern high energy particle accelerators.** Holmes, S.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1987. Contract AC02-76CH03000. 26p. (CONF-8707141—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004035/JAW.

From Theoretical advanced summer institute; Santa Fe, NM, USA (6 Jul 1987).

The purpose of these lectures is to convey an understanding of how particle accelerators work and why they look the way they do. The approach taken is physically intuitive rather than mathematically rigorous. The emphasis is on the description of proton circular accelerators and colliders. Linear accelerators are mentioned only in passing as sources of protons for higher energy rings. Electron accelerators/storage rings and antiproton sources are discussed only by way of brief descriptions of the features which distinguish them from proton accelerators. The basics of how generic accelerators work are discussed, focusing on descriptions of what sets the overall scale, single particle dynamics and stability, and descriptions of the phase space of the particle beam, the information thus presented is then used to go through the exercise of designing a Superconducting Super Collider. (LEW)

15712 **(INFN-LNF—87-92-P) Diffraction radiation model for energy losses.** Palumbo, L. (Istituto Nazionale di Fisica Nucleare, Frascati (Italy). Lab. Nazionale di Frascati). 1987. 6p. (CONF-8706147—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701070/JAW.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

The electromagnetic interaction of a bunch of particles with the surrounding equipment is cause of a radiation process leading to energy losses. The radiation may substantially reduce the energy gain of an accellerating structure therefore more power has to be supplied to the beam. Radiation laws derived by experimental observations and by some theoretical models predict an unrealistic infinite energy loss for infinitely short bunches. An analytical approach developed for an ideal simple structure which allows for deriving a radiation law for any bunch length and particle energy is here presented.

15713 **(INIS-GB—48) Daresbury 1985/1986.** (Daresbury Lab. (UK)). 1986. 56p. Daresbury Laboratory, Warrington WA4 4AD.

The paper is the annual report of the Daresbury Laboratory, United Kingdom, 1985/1986. The research programme using the Nuclear Structure Facility (NSF) and the Synchrotron Radiation Source (SRS) is described, along with some of the scientific highlights. The performance, operation and other activities associated with the SRS and NSF are summarized. Computational science studies concerned with atoms, molecules, condensed matter, chemical databank service and the FPS-164 computer system, are also outlined. (U.K.).

15714 (INIS-mf—11093, pp 45-49) **Application of the MGC cyclotron in Debrecen for practical purposes.** Ando, L.; Ditroi, F.; Fenyvesi, A.; Mahunka, I.; Szelecsenyi, F.; Takacs, S.; Tarkanyi, F.; Molnar, T. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete; Orvostudomanyi Egyetem, Debrecen, Hungary. Radiologiai Klinika). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

A small compact cyclotron (MGC) has been in operation at the Inst. of Nuclear Research, ATOMKI, Debrecen since November 1985. The cyclotron is used both for fundamental research in atomic and nuclear physics and for applications in the field of medical, industrial and agricultural practice. Several beam-lines (horizontal and vertical) are established for practical applications. The isotope production facilities are also presented, in addition to analytical applications. 3 figs.; 3 tables.

15715 **(IPNO-DRE—86-28) AGOR a supraconducting cyclotron for light and heavy ions.** Gales, S. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Oct 1986. 22p. (CONF-8610253—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751616/JAW.

From 4. Franco-Japanese colloquium on nuclear spectroscopy; Seillac, France (7 Oct 1986).

The main design characteristics of the AGOR K600 superconducting cyclotron are presented with special emphasis on the original aspects of the proposed accelerator: the acceleration of both light (protons up to 200 MeV) and heavy ions, the design of the axial injection and central region geometry, the magnet, the RF structures, the extraction system, and the solutions adopted for the cryostat and the superconducting coils. Examples of calculations on the beam dynamics and beam properties will be given. The actual project status is reviewed.

15716 **(LBL—23269) Mechanical design and construction of a 200 mA, 100 keV, dc, negative ion accelerator.** Purgalis, P.; Anderson, O.A.; Cooper, W.S.; Cummings, C.; Koehler, G.W.; Matuk, C.A.; Wells, R.P. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. 5p. (CONF-871007—79). NTIS, PC A02. Order Number DE88003855/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A volume production source and a 100 keV, dc, accelerator together with an additional, modular, 100 keV, electro static focused accelerator provide a starting point for a high energy H^-/D^- beam-line (200 keV to 800 keV), intended for fusion energy applications. The 100 keV accelerator tests started in June 1987. The mechanical design and construction of the accelerator is described. 3 refs., 8 figs.

15717 (LYCEN—8702, pp S.16.1-S.16.6) **Vivitron: an electrostatic accelerator of 35 MeV.** Frick, G.; Haas, F.; Letournel, M.; Seltz, R. (Centre de recherches nucleaires, 67-Strasbourg, France; Strasbourg Univ., 67, France). Mar 1987. (In French). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

The Vivitron is a 35 MV super-tandem. It integrates many novel approaches of electrostatic accelerator technology e.g. non subdivided insulating materials for a lighter column structure, discrete electrodes for better distribution of the stored energy, insulating posts between electrodes and tank allowing horizontal arrangement of a 50 m long machine... The critical components have been thoroughly tested in a 6 MV pilot generator. The project has been approved in 1985. Construction has begun in 1986. Presently the building is completed and the tank is being installed.

15718 **(RAL—86-061) ISIS annual report. For the financial year 1st April 1985 to 31st March 1986.** Biggin, S. (ed.). (Rutherford Appleton Lab., Chilton (UK)). Jul 1986. 116p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750847/JAW.

The paper is the first 1985/1986 report of the ISIS experimental facility for neutron scattering studies, which commenced operations June 1985, at the Rutherford Laboratory, United Kingdom. The report is divided into eight chapters, including: 1) accelerator, target station and moderators, 2) instruments and related science, 3) techniques, 4) future developments, 5) condensed matter theory research, 6) ISIS organisation and user interaction, 7) publications, and 8) experimental reports.

15719 **(SAND—87-1714C) Simulation of high current diodes for bremsstrahlung production.** Poukey, J.W.; Sanford, T.W.L. (Sandia National Labs., Albuquerque, NM (USA)). 9 Oct 1987. Contract AC04-76DP00789. 23p. (CONF-871105—3-Vugraphs). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004936/JAW.

From Meeting of the Division of Plasma Physics of the American Physical Society; San Diego, CA, USA (2 Nov 1987).

A 2-D electromagnetic PIC code (MAGIC) is used to study the design of Helia and Hermes-III electron diodes. Important issues include impedance vs. flow pattern, control of electron angles at the convertor, real-pulse and ion effects, and coupling to the MITL. This series of vugraphs presents the study.

15720 (SLAC-PUB—4146) Concluding talk-seminar on critical issues in development of new linear colliders. Panofsky, W.K.H. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Dec 1986. Contract AC03-76SF00515. 30p. (CONF-8608148—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005072/JAW.

From Symposium on critical issues in the development of new linear colliders; Madison, WI, USA (27 Aug 1986).

The growth of particle colliders is summarized, with their collision energy in the frame of the elementary constituents given for numerous specific machines. The logic concerning the design of electron-positron colliders and definition of parameters are briefly discussed. Several issues are covered which are presently uncertain, including beamstrahlung and interaction among beams of transverse dimensions in the angstrom range. Alternate power sources and their economy are considered as well as superconducting structures. (LEW)

15721 (SLAC-PUB—4448) Research at SLAC on future linear colliders. Wilson, P.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00515. 5p. (CONF-870632—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004377/JAW.

From International Europhysics conference on high energy physics; Uppsala, Sweden (25 Jun 1987).

This paper discusses current thinking at SLAC concerning the design of a newer collider that will have a luminosity on the order of 10^{33} cm^{-2} s^{-1} and a beamstrahlung energy loss on the order of .3. 13 refs., 1 fig., 1 tab. (LSP)

15722 (SLAC-PUB—4450) The status of the SLAC Linear Collider and of the Mark II detector. Lankford, A.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00515. 10p. (CONF-8708174—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004375/JAW.

From 7. international conference on physics in collision; Tsukuba, Japan (25 Aug 1987).

At SLAC we are currently involved in the exciting challenge of commissioning the first example of a new type of colliding beam accelerator, the SLAC Linear Collider, or SLC. The goals of the SLC are two-fold. It will explore the concept of linear colliders, and it will allow the study of physics on the Z^0 resonance. It accomplishes these goals by exploiting the existing SLAC linac and the large visible cross-section of approximately thirty nanobarns of the Z^0. The MARK II detector will have the opportunity to be first to explore the physics in this regime. This paper briefly reports the status of the SLC and of the MARK II as of early October 1987, at which time commissioning efforts were interrupted in order to place the MARK II detector at the collision point and to incorporate some improvements to the SLC. The first portion of this report highlights some of the milestones achieved in the SLC commissioning and some of the problems encountered. The last portion outlines improvements made to the MARK II for physics at the SLC. 10 refs., 12 figs., 1 tab.

15723 (SLAC-PUB—4465) Progress report on the SLAC Linear Collider. Kozanecki, W. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1987. Contract AC03-76SF00515. 9p. (CONF-870632—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004384/JAW.

From International Europhysics conference on high energy physics; Uppsala, Sweden (25 Jun 1987).

In this paper we report on the status of the SLAC Linear Collider (SLC), the prototype of a new generation of colliding beam accelerators. This novel type of machine holds the potential of extending electron-positron colliding beam studies to center-of-mass (c.m.) energies far in excess of what is economically achievable with colliding beam storage rings. If the technical challenges posed by linear colliders are solvable at a reasonable cost, this new approach would provide an attractive alternative to electron-positron rings, where, because of rapidly rising synchrotron radiation losses, the cost and size of the ring increases with the square of the c.m. energy. In addition to its role as a test vehicle for the linear collider principle, the SLC aims at providing an abundant source of Z^0 decays to high energy physics experiments. Accordingly, two major detectors, the upgraded Mark II, now installed on the SLC beam line, and the state-of-the-art SLD, currently under construction, are preparing to probe the Standard Model at the Z^0 pole. The SLC project was originally funded in 1983. Since the completion of construction, we have been commissioning the machine to bring it up to a performance level adequate for starting the high energy physics program. In the remainder of this paper, we will discuss the status, problems and performance of the major subsystems of the SLC. We will conclude with a brief outline of the physics program, and of the planned enhancements to the capabilities of the machine. 26 refs., 7 figs.

15724 (SLAC-PUB—4472) The status of the SLC. Ruth, R.D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1987. Contract AC03-76SF00515. 6p. (CONF-8710107—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004388/JAW.

From Future perspectives in high energy physics; Upton, NY, USA (5 Oct 1987).

On October 10,1987, the SLC ceased commissioning activities to move the Mark II detector into the beam line for the spring physics run. The planned shutdown is for a period of 13 weeks. In this paper, the various subsystems and their status as of October 10, 1987 are briefly discussed. 3 refs., 4 figs., 1 tab.

15725 (SLAC-PUB—4482) Perspectives on large linear colliders. Richter, B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1987. Contract AC03-76SF00515. 9p. (CONF-8708174—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004627/JAW.

From 7. international conference on physics in collision; Tsukuba, Japan (25 Aug 1987).

Three main items in the design of large linear colliders are presented. The first is the interrelation of energy and luminosity requirements. These two items impose severe constraints on the accelerator builder who must design a machine to meet the needs of experimentl high energy physics rather than designing a machine for its own sake. An introduction is also given for linear collider design, concentrating on what goes on at the collision point, for still another constraint comes here from the beam-beam interaction which further restricts the choices available to the accelerator builder. The author also gives his impressions of the state of the technology available for building these kinds of machines within the next decade. The paper concludes with a brief recommendation for how we can all get on with the work faster, and hope to realize these machines sooner by working together. 10 refs., 9 figs.

15726 (TRI-PP—87-85) The TRIUMF Kaon factory proposal. Blackmore, E.W. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1987. 7p. (CONF-8710125—9). NTIS (US Sales Only), PC A02. Order Number DE88900281/JAW.

From 2. review and planning workshop on antiproton science and technology; Santa Monica, CA, USA (6 Oct 1987).

The TRIUMF KAON factory will provide 30 GeV protons with an intensity of 100 μA, more than 80 times greater than that available at present in this energy range, and will be capable of producing correspondingly more intense beams of secondary particles, particularly kaons, antiprotons and neutrinos. The proposed accelerator consists of a chain of two rapid-cycling synchrotrons and three storage rings and uses as the injector the present 500 MeV TRIUMF H^- cyclotron. The system of accelerators, the proposed experimental areas and the current status of the proposal are described. Some comments on the use of the KAON factory as an antiproton source are included.

15727 (UCRL—97618) Induction linacs: A technology come of age for international cooperation. Barletta, W.A. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 11p. (CONF-8708201—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003953/JAW.

From 7. session of the international seminars on nuclear war; Erice, Italy (19 Aug 1987).

Recent developments in high reliability components for linear induction accelerators (LIA) make possible the use of LIAs as large scale, economical sources of radio-frequency (rf) power for

many large scale applications considered as World Laboratory projects. One particularly attractive example of interest to high energy physicists is a "two-beam accelerator" version of a linear e^+-e^- collider at TeV energies in which the LIA is configured as a monolithic relativistic klystron operating at 10 to 12 GHz. Another example of keen interest to the fusion community is the use of the LIA to drive a free-electron laser operating at 200 to 500 GHz for use in heating fusion plasmas via electron resonance cyclotron heating (ERCH). This paper describes briefly several potential uses of LIA radiation sources and scales present experience with LIAs to the operating characteristics applicable to large sources of rf power and synchrotron radiation. 14 refs., 6 figs.

15728 **New particle acceleration techniques.** Sessler, A.M. (Lawrence Berkeley Laboratory). *Physics Today;* **41**: No. 1, 26-37(Jan 1988).

The next generation of electron—positron colliders will have to be linacs with very large accelerating gradients provided by more or less novel techniques.

15729 **Possible applications of superconducting rf at LAMPF.** Thiessen, H.A. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 537-550(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

We discuss the possible applications of superconducting rf at LAMPF. These applications include 1) a LAMPF energy upgrade to 1.3 GeV, 2) an afterburner linac for an advanced hadron facility, 3) a pion linac (PILAC), 4) rf separators, 5) 800 MeV proton bunch rotators, 6) pion bunch rotators, and 7) a test cavity for the new high Tc superconducting materials. Cost estimates and performance are discussed.

15730 **Ground motion and its effects in accelerator design.** Fischer, G.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, CA 94305). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 2, 1047-1119(26 Feb 1987). (CONF-8507136—). Contract AC03-76SF00515.

From AIP summer school on high energy particle accelerators; Palo Alto, CA, USA (10 Jul 1985).

Reduction of beam aperture size to tens of centimeters in order to contain transverse phase space and the problem of the beam's wakefields interacting with the vacuum chamber and the accelerator structure has lead to concern over ground motion affecting accelerator alignment. A review of the types of geophysical phenomena which may affect accelerator design is given. (AIP)

15731 **Superconducting magnets.** Willen, E.; Dahl, P.; Herrera, J. (Brookhaven National Laboratory). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 2, 1228-1276(26 Feb 1987). (CONF-8507136—).

From AIP summer school on high energy particle accelerators; Palo Alto, CA, USA (10 Jul 1985).

Development and use of superconducting magnets in accelerators has been driven by cost considerations in the design of accelerators which can meet the needs of High Energy Physicists (i.e., TeV machines). In this article a self-consistent magnetic field theory will be developed which will be used to descibe a real magnet, its symmetries and its measurements. A measurement technique will be given. Then the magnet design for the SSC will be reviewed. (AIP)

15732 **Specialty magnets.** Halbach, K. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 2, 1277-1295(26 Feb 1987). (CONF-8507136—).

From AIP summer school on high energy particle accelerators; Palo Alto, CA, USA (10 Jul 1985).

This article is restricted to specialty magnet systems which employ permanent magnetic materials and can be used as an essential component or for special tasks in accelerators or storage rings. Emphasis will be placed on the concepts of the magnet system design rather than on specific details or all possible variations of a design. (AIP)

15733 **Dynamic devices: pickups and kickers.** Lambertson, G. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 2, 1413-1442(26 Feb 1987). (CONF-8507136—). Contract AC03-76SF00098.

From AIP summer school on high energy particle accelerators; Palo Alto, CA, USA (10 Jul 1985).

A large proportion of the dynamic devices used to interact with the charged-particle beams in accelerators or storage rings can be classified as pickups or kickers. These devices act through time-varying electromagnetic fields either to extract information about the particle's motion or to effect a change in that motion. A given configuration of electrodes may be used either as a pickup or as a kicker; that duality will be addressed in this paper.

15734 **Microwave sources and parameter scaling for high-frequency linacs.** Granatstein, V.L.; Mondelli, A. (Electrical Engineering Department, University of Maryland). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 2, 1505-1571(26 Feb 1987). (CONF-8507136—).

From AIP summer school on high energy particle accelerators; Palo Alto, CA, USA (10 Jul 1985).

Cost considerations in the design of high energy (TeV) accelerators have lead to the development of linear supercollider technology which is based upon higher rf (GHz) systems which can increase the accelerating gradient and reduce the size of the accelerating structure. Scaling of GHz rf systems and TeV energy accelerators and high rf source options are discussed in this article. (AIP)

15735 **Look at energy compression as an assist for high power RF production.** Birx, D.L.; Farkas, Z.D.; Wilson, P.B. (University of California, Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 2, 1572-1600(26 Feb 1987). (CONF-8507136—). Contract W-7405-ENG-48.

From AIP summer school on high energy particle accelerators; Palo Alto, CA, USA (10 Jul 1985).

The desire to construct electron linacs of higher and higher energies, coupled with the realities of available funding and real estate, has forced machine designers to reassess the limitations in both accelerator gradient (MeV/m) and energy.

15736 **Limiting technologies for particle beams and high energy physics.** Panofsky, W.K.H. (Stanford Linear Accelerator Center, Stanford University, Stanford, CA 94305). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 2, 1601-1618(26 Feb 1987). (CONF-8507136—).

From AIP summer school on high energy particle accelerators; Palo Alto, CA, USA (10 Jul 1985).

Two issues concerning accelerator technology are discussed in this article. One is this continued increase in energy of new accelerator facilities and the second is whether or not the unit cost of constructing accelerators will continue to decline. (AIP)

15737 **Circular machine design techniques and tools.** Servranckx, R.V.; Brown, K.L. (University of Saskatchewan, Saskatoon, Saskatchewan, Canada S7N-0W0). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 1, 121-149(25 Feb 1987). (CONF-850771—).

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

This report is based on a series of two lectures on Charged Particle Optics presented by the first author at the SLAC Accelerator Physics Summer School in July 1985 and on presentations made by both authors at the Second International Conference on Charged Particle Optics in Albuquerque, New Mexico, May 19—23, 1986.

15738 Single-particle dynamics in circular accelerators. Ruth, R.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 1, 150-235(25 Feb 1987). (CONF-850771—). Contract AC03-76SF00515.

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

The theory of single particle dynamics in circular accelerators is developed in this presentation. The Hamiltonian formulation of a relativistic particle in an electromagnetic field is used. (AIP)

15739 Dynamic aperture calculations for circular accelerators and storage rings. Douglas, D.R. (Continuous Electron Beam Accelerator Facility, 12070 Jefferson Avenue, Newport News, Virginia 23606). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 1, 390-473(25 Feb 1987). (CONF-850771—).

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

It is the author's hope that this document will help provide the novice with both an understanding of what dynamic aperture is and some insight as to why it is limited. In addition, we hope that this paper will provide information as to the analytical and numerical methods available for the study of dynamic aperture. Finally, we wish to present some interpretations and applications of these concepts and tools by means of examples. Those factors having an impact on the dynamic aperture of circular machines and storage rings will be discussed; applications to two types of machine of current popular interest (namely, large hadron colliders and synchrotron radiation electron storage rings) will be made in order to illustrate the ideas that are presented.

15740 Nonlinear behavior: One degree of freedom. Greene, J.M. (GA Technologies Inc., San Diego, California 92138). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 1, 603-630(25 Feb 1987). (CONF-850771—).

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

There has been very considerable progress in the past few years on the theory of two conservative, coupled, nonlinear oscillators. This is a very general theory, and applies to many equivalent systems including approximate models of particle accelerators. A typical problem of this class has a solution that is so complicated that it is impossible to find an expression for the state of the system that is valid for all time. However, recent results are making it possible to determine the next most useful type of information. This is the asymptotic behavior of individual orbits in the limit of very long times. It is just the information that is desired in many situations. For example, it determines the stability of the motion. They key to our present understanding is renormalization. The present state of the art has been described in Robert MacKay's thesis, for which this is an advertisement.

15741 Advanced accelerator concepts and electron-positron linear colliders. Siemann, R.H. (Accelerator Division, Fermi National Accelerator Laboratory, Batavia, Illinois 60510; Newman Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853). *Annual Review of Nuclear Science;* **37**: No. 1, 243-266(1987).

A review of state of the art e^+e^- linear accelerator technology is presented. Topics include scaling laws for e^+e^- linear colliders, wakefield, near-field, switched power, plasma, and collective implosion accelerators. (AIP)

15742 Alternatives to waste disposal of cyclotron facility at the Space Radiation Effects Laboratory, Newport News, Virginia. Yalcintas, M.G.; Fields, D.E. (Health and Safety Research Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 569-574 of Waste management '87: Waste isolation in the US, technical programs, and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Space Radiation Effects Laboratory located in Newport News, Virginia, was operated by the College of William and Mary for the National Aeronautics and Space Administration (NASA). The synchrocyclotron formerly in operation in this lab was removed in 1980. At several locations, the scattered radiation caused an induced radioactivity within the walls of the cyclotron room. A radiological survey has been performed to determine the amount of residual radioactivity on the walls. Calculations were performed to determine the thickness of the concrete walls and floors for shielding the residual radiation in the cyclotron room. One of the alternative for decommissioning was to remove the contaminated concrete material from the wall, which would present problems of disposing it. Recommendations were made to minimize exposure to a potential occupant working in the residual radioactivity on the walls and floor of the cyclotron room.

15743 Binary peak power multiplier and its application to linear accelerator design. Farkas, Z.D. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Microwave Theory and Techniques;* **MTT-34**: No. 10, 1036-1043(Oct 1986). Contract AC03-76SF00515.

This paper describes a new method of pulse compression, the binary power multiplier (BPM), a device which multiplies RF power in binary steps. It comprises one or more stages, each of which doubles the input power and halves the input pulse length. Practical designs are described and expressions for their compression efficiency are derived. The usefulness of pulse compression for accelerator design is illustrated and compared with the pulse compression system currently in use at the Stanford Linear Accelerator Center.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 14782, 15719, 15725, 15740, 15767, 15795, 16582

15744 (AD-A—185683/0/XAB) Modulation of an intense beam by an external microwave source - theory and simulation. Interim report. Krall, J.; Lau, Y.Y. (Naval Research Lab., Washington, DC (USA)). 7 Oct 1987. 17p. (NRL-MR—6083). NTIS, PC A03/MF A01.

A time-dependent, fully electromagnetic particle code is used to simulate the current modulation in an intense relativistic electron beam (IREB) by an external rf source. It is shown that the intense beam may serve as a power amplifier with good phase stability, as suggested in earlier experiments. Increase in beam bunching by the DC space charge is demonstrated with a simple analytical model.

15745 (BNL—40310) Transverse wake effects in an optical waveguide IFEL accelerator. Sandweiss, J. (Brookhaven National Lab., Upton, NY (USA)). 13 Aug 1987. Contract AC02-76CH00016. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004591/JAW.

A recent proposal describes a project to build a short demonstration stage IFEL accelerator using as input beam the output of the Accelerator Test Facility high brightness linac (ATF) currently under construction at BNL. A second stage of the proposal involves the design and construction of a GeV IFEL accelerator. Both IFEL accelerators could be built using standard focussing as discussed in the proposal. While this is fairly natural in the short (60cm) demonstration accelerator, it requires multiple refocussing for the 1 GeV machine. It would therefore be valuable if an optical waveguide could be used to contain the laser beam over the full length of the accelerator. However, it is clear that if the use of a waveguide is to compete with the direct focussing method, the aperture of the waveguide must be comparable to the laser beam waist for a Rayleigh length of $\simeq$ 30cm. In other words, the waveguide aperture must be at most a few mm. A natural concern for such close fitting structures is the effect of the wake fields produced in the waveguide by the beam. In particular, the wake fields produced by the front of the beam pulse may lead to Transverse oscillations of the rear of the beam pulse. Wilson's two particle

model of this head-tail effect is used to estimate the magnitude of the emittance growth in an optical waveguide IFEL accelerator. 6 refs., 2 tabs.

15746 **(BNL—40545) Performance of initial full-length RHIC [Relativistic Heavy Ion Collider] dipoles.** Dahl, P.; Cottingham, J.; Garber, M.; Ghosh, A.; Goodzeit, C.; Greene, A.; Herrera, J.; Kahn, S.; Kelly, E.; Morgan, G. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 4p. (CONF-870901—25). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004439/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

The first four full-length (9.7 m) R & D dipoles for the proposed Relativistic Heavy Ion Collider (RHIC) have been successfully tested. The magnets reached a quench plateau of approximately 4.5 T with very reasonable training - a field level comfortably above the design field of 3.45 T required for operation with beams of 100 GeV/amu gold nuclei. Measured field multipoles are considered to be quite acceptable for this series of R & D magnets.

15747 **(EFI—893(44)-86) Transformation coefficient in wave-field acceleration scheme.** Tsakanov, V.M. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700158/JAW.

A few schemes for wake-field acceration, allowing to have a high transformation coefficient are discussed. A wave-guide with dielectric filling is used as a moderator. 7 references, 5 figures.

15748 **(EFI—894(45)-86) Slow waves in waveguide with elliptical cross section.** Tsakanov, V.M. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700159/JAW.

A dispersion equation for determination of the wave propagation constant E/sub 11,C/ in a diaphragmed waveguide with elliptical cross section is obtained. Calculations are made to obtain slow waves able to accelerate particles in one of the ellipse foci. 3 references, 2 figures.

15749 **(EFI—905(56)-86) Motion of electrons in flat undulator fields induced by periodically curved current lines.** Ogandzhanyan, A.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700164/JAW.

It is shown, that a periodically curved current line of an arbitrary form can serve as a construction element for the technical realization of a flat undulator. Examples of such realizations are proposed and magnetic fields are determined for them. The equation of motion is solved in a paraxial approximation. This solution is a functional of the current line form. The direct binding of electron dynamics to the field sources will allow, in principle, to obtain the desired spectrum of electron radiation by the choice of the form of the field sources. In particular, high harmonics may be increased due to minimization of quenching of the magnetic field high harmonics from the neighbouring sections. 6 references.

15750 **(ITEF—39-1986) GERA computer code for calculation of two-dimensional electromagnetic fields in resonators and electron-optical systems by the finite element method.** Khapalov, S.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700678/JAW.

The GERA computer code designed for calculation of two-dimensional electromagnetic fields in resonators and electron-optical systems by the finite element method is described. Tetragonal and partial quadratic subparametric finite elements are used in the paper. The algebraic part of the program is realized on the basis of the program complex of the linear algebra, which allows to solve the systems of linear equations and to analyze the spectral composition of 10000 order matrices by the direct methods using the external memory. The results of numerical experiments are presented. 9 refs.; 10 figs.

15751 **(LBL—24175) Performance evaluation of PEP.** Zisman, M.S. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 29p. (CONF-8710242—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004575/JAW.

From Development of PEP as a radiation source conference; Stanford, CA, USA (20 Oct 1987).

An investigation of collective effects has been undertaken to assess the possibilities for using the low emittance operating mode of the PEP storage ring as a dedicated source of synchrotron radiation. Beam current limitations associated with longitudinal and transverse instabilities, and the expected emittance growth due to intrabeam scattering have been studied as a function of beam energy. Calculations of the beam lifetime due to Touschek and gas scattering are presented, and the growth times of coupled-bunch instabilities are estimated. In general, the results are encouraging, and no fundamental problems have been uncovered. It appears that beam currents up to about 10 mA per bunch should be achievable, and that the emittance growth is not a severe problem at an energy of about 8 GeV. A feedback system to deal with coupled-bunch instabilities is likely to be required. 7 refs., 13 figs.

15752 **(LBL—24308) Partial coherence and spectral brightness at x-ray wavelengths.** Attwood, D.; Kim, Kwang-Je. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 8p. (CONF-8708180—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004562/JAW.

From Symposium on X-ray microscopy; Upton, NY, USA (31 Aug 1987).

Microscopic examination of physical and biological systems requires short wavelength radiation which can be focused to very small dimensions. Indeed it is possible in the limit to both "see" and "write" features approaching the radiation wavelength λ, and furthermore to identify particular chemical elements through their characteristic electronic transitions. Sources of radiation which can deliver a substantial flux of photons to very small dimensions are said to be of high brightness. Sources of high brightness radiate a large photon flux (photons/second), from a small area . solid angle product ($\Delta A \cdot \Delta\Omega$). If, in addition, the photons are emitted within a spectrally narrow region, $\Delta\lambda$, the radiation is said to be of high spectral brightness. The focussability of such radiation is, however, set by additional attributes of spatial coherence and, of course, by available optics. The emphasis in this paper is on radiation which is not only of high spectral brightness, but which has additional attributes which permit it to be focused to dimensions approaching that set by its finite wavelength, λ. With a near perfect lens such radiation could be focused to dimensions approaching the Rayleigh limit, 1.2 Fλ, where F is the lens F number. Spatially coherent radiation, capable of being focused to wavelength limited dimensions, is often referred to as "diffraction limited." 14 refs., 8 figs.

15753 **(NIIEFA-P-V—0696) Energy spectra of electron linac with a magnetron as HF power supply.** Svistunov, Yu.A.; Smirnov, V.L.; Shchepin, Yu.P. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700274/JAW.

The calculated electron energy spectrum obtained by numerical simulation of three-dimensional particle dynamics in the assumption of a δ-like spectrum of the magnetron is compared with the experimental one measured by a spectrum analyzer. The effect of instabilities of the magnetron frequency and amplitude of high-frequency power pulse on the electron spectrum width at the electron linac output is discussed. It is shown that if the calculated spectrum is considered to be instantaneous the spectrum width can be determined by integration over the whole range of average energy variation of particles as close as it is observed in the experiment. The measurements and calculations are made for the LUEh-8-5V linac. 7 references, 7 figures.

15754 **(SLAC-PUB—4479) Final focus systems for linear colliders.** Erickson, R.A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1987. Contract AC03-76SF00515. 40p. (CONF-840873—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004905/JAW.

From US summer school on high energy particle accelerators; Batavia, IL, USA (13 Aug 1984).

The final focus system of a linear collider must perform two primary functions, it must focus the two opposing beams so that their transverse dimensions at the interaction point are small enough to yield acceptable luminosity, and it must steer the beams together to maintain collisions. In addition, the final focus system must transport the outgoing beams to a location where they can be recycled or safely dumped. Elementary optical considerations for linear collider final focus systems are discussed, followed by chromatic aberrations. The design of the final focus system of the SLAC Linear Collider (SLC) is described. Tuning and diagnostics and steering to collision are discussed. Most of the examples illustrating the concepts covered are drawn from the SLC, but the principles and conclusions are said to be generally applicable to other linear collider designs as well. 26 refs., 17 figs. (LEW)

15755 (ZfK—594, pp 12-15) **Ion beam deflection by means of a stator magnet.** Eichhorn, K.; Preusche, S. Jul 1987. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780042/JAW.

In Publications from the department of large-scale devices of the Central Institute of Nuclear Research at Rossendorf.

In carrying out irradiations with accelerated ions often a homogeneous distribution of the ion beam at the target is required. In the paper a method is presented to obtain a homogeneous target irradiation by the deflection of the beam using the stator of a motor.

15756 **Effect of accelerating gap geometry on the beam breakup instability in linear induction accelerators.** Miller, R.B.; Marder, B.M.; Coleman, P.D.; Clark, R.E. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* 63: No. 4, 997-1008(15 Feb 1988). Contract AC04-76DP00789.

The electron beam in a linear induction accelerator is generally susceptible to growth of the transverse beam breakup instability. In this paper we analyze a new technique for reducing the transverse coupling between the beam and the accelerating cavities, thereby reducing beam breakup growth. The basic idea is that the most worrisome cavity modes can be cutoff by a short section of coaxial transmission line inserted between the cavity structure and the accelerating gap region. We have used the three-dimensional simulation code S-smcapsO-smcapsS-smcaps to analyze this problem. In brief, we find that the technique works, provided that the lowest TE mode cutoff frequency in the coaxial line is greater than the frequency of the most worrisome TM mode of the accelerating cavity.

15757 **Image charge focusing of relativistic electron beams.** Humphries S. Jr.; Ekdahl, C.B. (Institute for Accelerator and Plasma Beam Technology, Department of Electrical and Computer Engineering, University of New Mexico, Albuquerque, New Mexico 87131). *Journal of Applied Physics;* 63: No. 2, 583-585(15 Jan 1988).

Experimental results are reported on the transport of a relativistic electron beam by image charge effects. The transport system consisted of a cylindrical metal tube periodically interrupted by transverse conducting grids with high transparency. Partial cancellation of the beam electric fields increased the space-charge-limited current level, allowing propagation in a magnetically self-pinched mode. A 400-keV, 4-kA beam traveled 30 cm in high vacuum through 10 focusing foils. Capture of the beam was almost 100% efficient; beam emittance was not severely degraded during capture and transport. The radius of the self-contained beam was 1.4 cm; the beam position was centered by the image current in the transport tube to within 1 mm. The favorable results imply that image charge focusing could be considered for transport in high-current linear induction accelerators.

15758 **Iron dominated magnets.** Fischer, G.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, CA 94305). *AIP (American Institute of Physics) Conference Proceedings;* 153: No. 2, 1120-1227(26 Feb 1987). (CONF-8507136—). Contract AC03-76SF00515.

From AIP summer school on high energy particle accelerators; Palo Alto, CA, USA (10 Jul 1985).

These two lectures on iron dominated magnets are meant for the student of accelerator science and contain general treatments of magnet design and construction. The areas covered are general concepts and cost considerations, profile configuration and harmonics, magnetic measurements, a few examples of "special magnets," and materials and practices. An extensive list of references is provided.

15759 **Longitudinal motion in circular accelerators.** Cole, F.T. (Argonne National Laboratory). *AIP (American Institute of Physics) Conference Proceedings;* 153: No. 1, 44-82(25 Feb 1987). (CONF-850771—).

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

The formalism behind the motion of particles in circular accelerators storage rings is detailed in this review. Particular attention is given to the theoretical description of the dynamics of longitudinal motion of particle beams. (AIP)

15760 **Space charge effects: Tune shifts and resonances.** Weng, W.T. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *AIP (American Institute of Physics) Conference Proceedings;* 153: No. 1, 348-389(25 Feb 1987). (CONF-850771—). Contract AC03-76SF00515.

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

Space charge effects are due to the electromagnetic fields of the charged particles in a particle beam. The motion of a particle in the accelerator may be modified by the field of neighbor particles in the beam (if the fields are strong enough). Within this article space charge is formally defined and effects related to it, particularly, tune shifts and resonances, are discussed. (AIP)

15761 **Resonances in accelerators.** Talman, R. (SSC Central Design Group, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* 153: No. 1, 835-864(25 Feb 1987). (CONF-850771—).

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

Various resonances important in accelerators are analyzed, with the intention of demonstrating their essential similarity. Transverse instabilities of bunched electron beams are emphasized, including beam—beam effects.

15762 **Wakefield effects in a linear collider.** Bane, K.L.F. (Stanford Linear Accelerator Center, Stanford University, Stanford, CA 94305). *AIP (American Institute of Physics) Conference Proceedings;* 153: No. 1, 971-1014(25 Feb 1987). (CONF-850771—). Contract AC03-76SF00515.

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

Wakefields in the SLAC accelerating structure are the subject of this lecture. The effects of the transverse wakefield on the beam will be the main concern of this discussion. Energy variations along beam bunches and Landau damping are discussed. The results of modeling and simulation studies of wakefields and their effects on electron beams are described. (AIP)

15763 **Applications for a general purpose optical beam propagation code.** Munroe, J.L.; Wallace, N.W. (Los Alamos National Labs., P.O. Box 1663, MS B231, Los Alamos, NM 87545). pp 119-122 of Present trends in optical systems design: Computer lens design workshop. Londono, C.; Fischer, R.E. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870132—).

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

Real world beam propagation and diffraction problems can rarely be solved by the analytical expressions commonly found in optics and lasers textbooks. These equations are typically valid only for paraxial geometries, for specific boundary conditions (e.g., infinite apertures), or for special assumptions (e.g., at focus). Numerical techniques must be used to solve the equations for the general case. LOTS, a public domain numerical beam propagation software package developed for this purpose, is a widely used and proven tool. The graphical presentation of results combined with a well designed command language make LOTS particularly user-friendly, and the recent implementation of LOTS on the IBM PC/XT family of desktop computes will make this capability available to a much larger group of users. This paper surveys several applications demonstrating the need for such a capability.

15764 **Calculated fraction of an incident current pulse that will be accelerated by a linear electron accelerator and comparisons with experimental data.** Alsmiller, F.S.; Alsmiller, R.G. Jr.; Lewis, T.A. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* 52: 392-393(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In a series of previous papers, calculated results were presented to aid in the design of a prebuncher for the Oak Ridge Electron Linear Accelerator (ORELA). The velocity distribution of the electrons in the bunched beam is quite different from that in the unbunched beam and therefore it is not clear how much of the bunched beam will be accelerated by the existing accelerator. A model based on the work of Slater was used to determine the fraction of the bunched beam that would be picked up and accelerated by ORELA. This model requires a knowledge of the amplitude of the longitudinal electron field for the dominant mode of the traveling wave in the accelerator. This amplitude, E/sub AO/, is not well established and a direct measurement is not feasible, so a series of experimental measurements using three current monitors have been performed to obtain the data necessary to determine this amplitude indirectly. This was done by comparing experimental results for the pickup fractions at different energies with calculated fractions as functions of E/sub AO/ and energy. In this paper, these data will be given, the methods used to determine this amplitude will be described, and comparisons between experimental data and other calculated results will be presented.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 15584, 15668, 15714, 15739, 15757, 15876, 16471

15765 **(BNL—40314) The implementation of artificial intelligence in control systems.** Koul, R.; Weygand, D.P. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 12p. (CONF-8709151—9). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88003497/JAW.

From Europhysics conference on control systems for experimental physics; Villars, Switzerland (28 Sep 1987).

Some concepts of artificial intelligence are reviewed, particularly as they apply to control systems of accelerators. Logical representation and formal reasoning are discussed briefly, as well as production systems, which describe various systems based on the idea of condition-action pairs (productions). Procedural knowledge, which deals with routine activities that rarely require change, is described. Frames are defined, which provide a convenient structure for representing knowledge. Frames consist of information about objects. For a given frame there are various slots, and for each slot there are various facets, each containing various data. Direct analogical representation is defined as a class of representation which represents knowledge in a natural analog manner, allowing observation of facts in many cases to be achieved quickly and easily compared to deduction. Architecture of systems applied to accelerator control is then described. (LEW)

15766 **(BNL—40462) Algorithms and procedures in the model based control of accelerators.** Bozoki, E. (Brookhaven National Lab., Upton, NY (USA)). Oct 1987. Contract AC02-76CH00016. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004592/JAW.

The overall design of a Model Based Control system was presented. The system consists of PLUG-IN MODULES, governed by a SUPERVISORY PROGRAM and communicating via SHARED DATA FILES. Models can be ladded or replaced without affecting the oveall system. There can be more then one module (algorithm) to perform the same task. The user can choose the most appropriate algorithm or can compare the results using different algorithms. Calculations, algorithms, file read and write, etc. which are used in more than one module, will be in a subroutine library. This feature will simplify the maintenance of the system. A partial list of modules is presented, specifying the task they perform. 19 refs., 1 fig.

15767 **(BNL—40507) Betatron oscillations in a free electron laser.** Yu, Li-Hua; Krinsky, S. (Brookhaven National Lab., Upton, NY (USA)). Nov 1987. Contract AC02-76CH00016. 10p. (CONF-8709110—19). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004859/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

A dispersion relation is used to study the effect of betatron oscillations on the gain of a guided mode in a free electron laser operating in the high-gain regime before saturation. We assume the electron beam to be matched to the natural focussing of a helical wiggler, and our treatment includes the effects of the finite energy spread and emittance of the electron beam, the transverse gradient in the wiggler, and the variation of the electromagnetic wave transverse phase experienced by the electrons due to betatron oscillations.

15768 **(CEA-CONF—9081) Graphics software of the Saclay linear accelerator control system.** Gournay, J.F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de l'Accelerateur Lineaire). Jun 1987. 5p. (CEA-DPH-N-S—2443B; CONF-8706252—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751352/JAW.

From 7. summer school on computing techniques in physics; Bechyne, Czechoslovakia (9 Jun 1987).

The Control system of the Saclay Linear Accelerator is based upon modern technology hardware. In the graphic software, pictures are created in exactly the same manner for all the graphic devices supported by the system. The informations used to draw a picture are stored in an array called a graphic segment. Three output primitives are used to add graphic material in a segment. Three coordinate systems are defined.

15769 **(DOE/ER—0358) Panel on high-T/sub c/ superconducting magnet applications in particle physics.** (USDOE Office of Energy Research, Washington, DC). Dec 1987. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005320/JAW.

A study was performed of the possible use of the recently discovered high-temperature oxide superconductors for magnetic-field generation in particle-physics accelerators. The technical requirements of the Superconducting Super Collider were used as a benchmark. The three specific issues examined are: the status of high-T/sub c/ superconductivity together with the materials requirements for accelerator applications, technical obstacles to be overcome, and a time scale for development. The study found that, although not yet demonstrated, there is reason to believe that the candidate material yttrium barium cuprate ($YBa_2Cu_3O_7$) could with further development satisfy the critical-current and critical-field requirements. It is estimated that another 4 years is required to develop designs and processes leading to demonstration of continuous lengths of composite filamentary superconductor and another 8 years to develop an acceptable cable and winding technique and to demonstrate these in a full-scale accelerator-quality dipole magnet. (LEW)

15770 (DOE/ER/40124—15) The University of Washington Superconducting Booster Accelerator Project: Status report. Storm, D.W. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1987. Contract AC06-84ER40124. 10p. (CONF-8709217—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004233/JAW.

From SNEAP conference; Tallahassee, FL, USA (27 Sep 1987).

The University of Washington Superconducting Booster was proposed in 1982 and funded in December 1983. The goals were to be able to accelerate particles from protons to middle weight ions using our 9-MV FN tandem as an injector. Because we planned to accelerate lighter ions than other laboratories, we conceptualized the accelerator around "low-beta" resonators of β near 0.1 and high-beta resonators of some value from 0.16 to 0.2. The final plans were based on lead-plated copper quarter-wave resonators. We adapted a design of Ben-Zvi and Brennan for our $\beta = 0.1$ resonator and designed a new $\beta = 0.2$ quarter-wave resonator. In addition to the LINAC, we have built a 300-KV injector deck, which has our old direct extraction source and a new General Ionex 860 sputter source, and we have built a gridded buncher which runs at 50 MHz. These are fully operational. We give a brief description of the LINAC. Then we discuss resonator construction and the rf control system. We describe our operating experience and recent tests. Our most recent experience involved providing a ^{7}Li beam for the first nuclear physics experiment done with the new accelerator. 12 refs., 4 figs.

15771 (FNAL/C—87/149) Channeling and dechanneling at high energy. Carrigan, R.A. Jr. (Fermi National Accelerator Lab., Batavia, IL (USA)). 30 Sep 1987. Contract AC02-76CH03000. 27p. (CONF-8710159—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003989/JAW.

From 12. international conference on atomic collisions in solids; Okayama, Japan (12 Oct 1987).

The possibility of using channeling as a tool for high energy particle physics has now been extensively investigated. Bent crystals have been used as an accelerator extraction element and for particle deflection. Applications as accelerating devices have been discussed but appear remote. The major advantage in using a bent crystal rather than a magnet is the large deflection that can be achieved in a short length. The major disadvantage is the low transmission. A good understanding of dechanneling is important for applications. 43 refs., 1 fig., 3 tabs.

15772 (FNAL/C—87/162) User friendly far front ends. Zagel, J.R.; Chapman, L.J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1987. Contract AC02-76CH03000. 4p. (CONF-8709151—8). NTIS, PC A02. Order Number DE88004036/JAW.

From Europhysics conference on control systems for experimental physics; Villars, Switzerland (28 Sep 1987).

For years controls group hardware designers have designed microprocessor systems to accomplish specific functions such as refrigeration control. These systems often require years of software effort. The backlog of requests for even simple additions or modifications to software in embedded controllers has become overwhelming. We discuss the requirements of "far forward" controllers. Can we build a system that is modular enough to be configurable for specific applications without sacrificing performance? The hardware and software framework must be complete enough to isolate the end user from the peculiarities of bit and byte manipulation, but still allow system specifics to be implanted by the user. It is time to provide embedded controller systems as easy to use as workstation consoles.

15773 (IPNO—86-02) Acquisition system of tandem injector parameters. Decourt, M. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1986. 38p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751610/JAW.

The system centralizes all the parameters belonging to the accelerator injector. The acquisition center system reinforces an original device made of cameras and video receivers. Besides giving access to all the parameters of the ion source, the new system allows, in the "OSCILLO" mode, to visualize in real time any channel on the oscilloscope.

15774 (LA—11189-MS) A ring model of the lasertron. Tallerico, P.J.; Coulon, J.P. (Los Alamos National Lab., NM (USA)). Jan 1988. Contract W-7405-ENG-36. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004656/JAW.

A large-signal, 2-1/2 dimensional relativistic particle dynamics code has been written to simulate the electrical behavior of the lasertron. The theory and the approximations involved in this code are discussed in detail. Numerical results are presented to show the comparison with previous work and to show the general variation in lasertron performance with frequency, beam voltage, and beam current. The code has also been used to design a prototype 6-GHz lasertron for construction at the Laboratoire de l'Accelerateur Lineaire in Orsay, France. The calculations show that this prototype can produce 4.7-MW peak-power output with a conversion efficiency of 65%. At 3 GHz, the power would be increased by a factor approaching 10, and the conversion efficiency would be over 70%.

15775 (LA-UR—87-3258) Adaptive control technique for accelerators using digital signal processing. Eaton, L.; Jachim, S.; Natter, E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-8709151—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004322/JAW.

From Europhysics conference on control systems for experimental physics; Villars, Switzerland (28 Sep 1987).

The use of present Digital Signal Processing (DSP) techniques can drastically reduce the residual rf amplitude and phase error in an accelerating rf cavity. Accelerator beam loading contributes greatly to this residual error, and the low-level rf field control loops cannot completely absorb the fast transient of the error. A feedforward technique using DSP is required to maintain the very stringent rf field amplitude and phase specifications. 7 refs.

15776 (LAL-RT—87-07) Lasertron performance simulation. Dubrovin, A.; Coulon, J.P. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). May 1987. 32p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751632/JAW.

This report presents a comparative simulation study of the Lasertron at different frequency and emission conditions, in view to establish choice criteria for future experiments. The RING program for these simulations is an improved version of the one presented in an other report. The self-consistent treatment of the R.F. extraction zone is added to it, together with the possibility to vary initial conditions to better describe the laser illumination and the electron extraction from cathode. Plane or curved cathodes are used.

15777 (LBL—23064) The use of toroidal boundary conditions in the program POISSON. Caspi, S.; Helm, M.; Laslett, L.J. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 5p. (CONF-870901—27). NTIS, PC A02. Order Number DE88003868/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

In circular particle accelerators of moderate size, one cannot entirely neglect the curvature of the structure and of the guide field. In practice, one may wish to restrict the region of analysis to that near the working aperture, while excluding a very substantial area closer to (and including) the axis of rotational symmetry. In this way, a more efficient mesh can be generated for a program such as POISSON. In restricting the solution to the region of interest, there must be concern regarding a suitable termination of the problem at the boundary of the mesh. For these reasons, we have employed toroidal coordinates in constructing the boundary to a relaxation mesh, and in formulating the boundary conditions that then would be imposed at such boundaries. 11 refs., 6 figs.

15778 (LBL—23102) Design, fabrication, and calibration of a cryogenic search-coil array for harmonic analysis of quadrupole magnets. Green, M.I.; Barale, P.J.; Hassenzahl, W.V.; Nelson, D.H.; O'Neill, J.W.; Schafer, R.V.; Taylor, C.E. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 5p. (CONF-870901—20). NTIS, PC A02. Order Number DE88003911/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

A cryogenic search-coil array has been fabricated at LBL for harmonic error analysis of SSC model quadrupoles. It consists of three triplets of coils; the center-coil triplet is 10 cm long, and the end coil triplets are 70 cm long. Design objectives are a high bucking ratio for the dipole and quadrupole signals and utility at cryogenic operating currents (~6 kA) with sufficient sensitivity for use at room-temperature currents (~10 A). the design and fabrication are described. Individual coils are mechanically measured to +-5 μm, and their magnetic areas measured to 0.05%. A computer program has been developed to predict the quadrupole and dipole bucking ratios from the mechanical and magnetic measurements. The calibration procedure and accuracy of the array are specified. Results of measurements of SSC model quadrupoles are presented. 1 ref., 4 figs.

15779 **(LBL—23110) Use of tapered key collars in dipole models for the SSC.** Peters, C.; Mirk, K.; Wandesforde, A.; Taylor, C. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 5p. (CONF-870901—26). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004557/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

Three one-meter SSC type dipole magnet models have been constructed and tested using tapered keys to lock interleaving aluminum alloy collars around the coils. This design enables the coil prestress to be created by hoop tention in the collars as the keys are pressed in. This method minimizes the high coil overstress required to insert traditional non-tapered keys. In particular, collaring may be accomplished without exceeding 10,000 psi coil pressure while producing in excess of 7500 psi coil pressure after collaring. Significantly, this design enables aluminum collars to be used with their advantage of maintaining coil prestress during cooldown. Coil prestress measured during and after the collaring of the three one-meter models will be given. A description of the design, including FEA analysis, and the forces required to key the collars, will be given.

15780 **(LBL—23909) Operating experience with the LBL ECR source.** Lyneis, C.M. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 16p. (CONF-8711107—4). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005479/JAW.

From International conference on ECR ion sources and their applications; East Lansing, MI, USA (16 Nov 1987).

The overall performance of the LBL ECR source in providing beam for the 88-Inch Cyclotron has been excellent. However, during the past two years there have been some fluctuations in the peak performance, particularly for the highest charge states. Among the factors which influence the peak performance are coatings from solid feeds or gases such as SiH_4 or CO_2, changes in first stage output, and variation in outgassing rates on the wall. Modifications made to the source have also affected its performance. In the plasma chamber the screens between the sextupole bars were removed to lower its Q_0. When the 9.2 GHz klystron used to power the first stage failed, it was replaced by a 10.3 GHz klystron. Tests were also made using 6.4 GHz to drive both first and second stages. The source performance in these various configuration will be reviewed.

15781 **(NIIEFA-P-F—0685) Nuclear-physical methods for measuring beam energy spread.** Bortnyanskij, A.L. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 43p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700272/JAW.

Theoretical basis for experimental data processing methods are described to gain information, concerning accelerator beam energy spectrum. Metrological aspect of the problem is considered. To determine energy spread, threshold and resonance nuclear reactions are used. The developed methods take into account the accelerated particle energy loss fluctuations under stopping in the target; recommendations, concerning the measurement result correction, are made. Processing of nuclear reaction excitation functions, obtained experimentally, is illustrated by examples. 38 references, 3 figures.

15782 **(NIIEFA-P-V—0691) Analysis of decelerating coupled cavity slit systems by the partial region method.** Orlov, A.K. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700273/JAW.

Theoretical peculiarities of slit-loaded resonator chain electrodynamic characteristic calculation by partial region method are presented. Numerical results for systems with azimuthal and radial slits are given; a comparison with experimental data is made. The results presented show, that the partial region method offers a precise description of electromagnetic phenomena in the slit loaded resonator system at least in relation to the considered boundary surfaces, permitting variable separation. In this case the field continuity is provided in a natural way, and the necessity of magnetic potential introduction is eleminated. The data obtained allow one to calculate fields in the slit vicinity and to estimate the error, occuring under the use of eigenfunction decomposition of a system with metallized coupling holes. This fact may be useful during the calculation of structures with complex geometry, as for example, with Ω-shape one. 9 references, 5 figures.

15783 **(SAND—86-8927) Neutral particle beam scoring system proof-of-principle experiment.** Tichenor, D.A.; Pontau, A.E.; Antolak, A.J. (Sandia National Labs., Livermore, CA (USA)). Oct 1986. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87001665/JAW.

A method of scoring a ground-based neutral particle beam pointing experiment is described. Beam scoring in this context means performing beam direction measurements in the near field (tens of meters) sufficient to determine whether energy would be concentrated on a far-field target as desired in a pointing experiment. The principle of operation is to impress a high-resolution spatial modulation on the beam by inserting an array of shadow wires into the beam upstream of the steering magnet. At the downstream end of the beam line the shadows are detected using one or more scintillation screens and video cameras. Beam direction is determined by measuring the location of the shadows at a known distance downstream of the point of steering. A proof-of-principle experiment demonstrates that: (1) wire shadows can be created in a 50 MeV beam and propagate over the distances required; (2) images of sufficient brightness and resolution can be formed on scintillating screens excited by 50 MeV protons; and (3) CCD array cameras can operate in the radiation environment created near the beam line.

15784 **(SLAC/AP—59) RF pulse compression development.** Farkas, Z.D.; Weaver, J.N. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00515. 17p. NTIS, PC A03. Order Number DE88004818/JAW.

The body of this paper discusses the theory and some rules for designing a multistage Binary Energy Compressor (BEC) including its response to nonstandard phase coding, describes some proof-of-principle experiments with a couple of low power BECs, presents the design parameters for some sample linear collider rf systems that could possibly use a BEC to advantage and outlines in the conclusion some planned R and D efforts. 8 refs., 26 figs., 4 tabs.

15785 **(TRI-PP—87-86) Concepts for the design of magnets at target locations subjected to very high radiation levels.** Otter, A.; Hojvat, C. (Fermi National Accelerator Lab., Batavia, IL (USA); TRIUMF, Vancouver, British Columbia (Canada)). 1987. Contract AC02-76CH03000. 4p. (CONF-870901—29). NTIS, PC A02. Order Number DE88004745/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

Magnets for advanced hadron facility secondary beam lines will be positioned close to targets at which nuclear radiation levels

will be about 10^3 rad/h. New designs are proposed in which the magnet coils are remote from the beam apertures and are shielded from radiation by the poles or other non-magnetic shielding material. The magnet yokes and poles are integrated into the radiation shielding surrounding the targets. If necessary, the coils can be removed for servicing without exposing the parts of the magnet with very high residual radiation fields. It will also be unnecessary to have vacuum joints adjacent to the magnets because the parts of the magnet close to the beam tube should never have to be removed for maintenance.

15786 (ZfK—594, pp 30-35) **Process control of accelerators.** Baldauf, D.; Borkenhagen, M.; Fuelle, R.; Hartmann, B.; Hiekmann, S.; Hofmann, G.; Linnemann, W.J. Jul 1987. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780042/JAW.

In Publications from the department of large-scale devices of the Central Institute of Nuclear Research at Rossendorf.

A computer system with distributed intelligence for accelerator control, its software and the man-machine-communication are described. The application of the system is demonstrated by various examples.

15787 (ZfK—594, pp 3-6) **Negative ion sputter source MISS-585.** Matthes, H.; Pfestorf, W. Jul 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780042/JAW.

In Publications from the department of large-scale devices of the Central Institute of Nuclear Research at Rossendorf.

A brief description of the newly designed negative ion sputter source MISS-585 is given. The sputter source MISS-585 represents a more powerful and reliable version of the model MISS-483. In discussing the source performance emphasis is given on the effect of the temperature of the sputter surface on the negative ion yield in a wide range of temperatures and for different species of ions.

15788 (ZfK—594, pp 7-8) **Multicharged lithium Penning ion source for the cyclotron.** Dietrich, J.; Kerber, G.; Odrich, H.; Naumann, W. Jul 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780042/JAW.

In Publications from the department of large-scale devices of the Central Institute of Nuclear Research at Rossendorf.

An internal hot cathode Penning ion source using a vaporizer without external heating was developed for the acceleration of lithium ions with the Rossendorf cyclotron U-120.

15789 (ZfK—594, pp 9-10) **Acceleration of /sup 20/Ne/sup 3+/ and /sup 20/Ne/sup 4+/ ions at the Rossendorf cyclotron U-120.** Dietrich, J.; Guratzsch, H.; Kerber, G.; Naumann, W.; Odrich, H. Jul 1987. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780042/JAW.

In Publications from the department of large-scale devices of the Central Institute of Nuclear Research at Rossendorf.

The acceleration of /sup 20/Ne/sup 3+/ (0.6 MeV/u) and /sup 20/Ne/sup 4+/ (1.1 MeV/u) ions at the Rossendorf cyclotron U-120 is described.

15790 (ZfK—594, pp 11) **Reconstructed pulsed arc power source for the Rossendorf cyclotron ion source.** Hartmann, P. Jul 1987. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780042/JAW.

In Publications from the department of large-scale devices of the Central Institute of Nuclear Research at Rossendorf.

A new power supply of the pulsed arc current for the Rossendorf cyclotron ion source has been constructed. A stable regime of the pulsed voltage up to 1 kV is available.

15791 (ZfK—594, pp 16-18) **Irradiation system for target materials with low heat transmission.** Brueckner, R.; Gurtzsch, H. Jul 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780042/JAW.

In Publications from the department of large-scale devices of the Central Institute of Nuclear Research at Rossendorf.

An irradiation system developed for target materials with low heat transmission is described. Specially the cooling system of the target is illustrated.

15792 (ZfK—594, pp 19-21) **Beam profile monitor system based on infrared thermography.** Buettig, H. Jul 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780042/JAW.

In Publications from the department of large-scale devices of the Central Institute of Nuclear Research at Rossendorf.

The beam profile monitor system based on infrared thermography provides a direct visual representation of the relative particle density distribution over the total cross section of a particle beam. Advantages of this monitor system, such as monitoring of the total beam cross section, fast scanning (video frequency), no vacuum feedthrough and applicable to high beam power result in an easy beam handling.

15793 **Description of beam position monitor signals with harmonic functions and their Taylor series expansions.** Halbach, K. (Lawrence Berkeley Lab., CA, USA). *Nuclear Instruments and Methods in Physics Research;* **260**: No. 1, 14-32(1 Oct 1987).

Under most circumstances, appropriately processed signals from electric or magnetic beam sensing systems can be described by the real or imaginary part of the Taylor series expansion of an analytical function of a complex variable. This description can provide very good understanding of such signals and can be used to great advantage for the design of beam position monitor systems.

4304 Storage Rings

REFER ALSO TO CITATION(S) 14782, 15751

15794 (CEA-CONF—9020) **European proposals for a B-factory.** Duclos, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Apr 1987. 3p. (CEA-DPH-N-S—2455B; CONF-8703136—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751335/JAW.

From Elementary structure of materials; Les Houches, France (24 Mar 1987).

Published in summary form only.

15795 (LBL—23942) **Correction of the field in the SSC dipoles using superconductor on the wedges.** Green, M.A.; Talman, R.M. (Lawrence Berkeley Lab., CA (USA); Cornell Univ., Ithaca, NY (USA)). Sep 1987. Contract AC03-76SF00098. 7p. (CONF-870901—21). NTIS, PC A02. Order Number DE88004573/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

The SSC colliding beam storage ring requires superconducting magnets capable of producing a magnetic field of 6.6 T which has very high accuracy. For many of the multipoles, that multipole must be reduced (at a radius of 1 centimeter) to the order of 0.2 parts in 10,000. This field accuracy is dictated by the physics of storing very small high-current proton beams at energies ranging from 1 TeV to 20 TeV. Magnetization of the superconductor can cause sextupole field errors of up to 6 parts in 10,000 at an injection field of 0.33 T at a radius of 1 centimeter. Saturation of the magnet iron can induce sextupole field errors of 1 to 2 parts in 10,000 at the full field of 6.6 T. Manufacturing errors can induce other multipole components, both normal and skew. The SSC coil has three wedges separating the superconducting coil blocks on the inner layer of the coil. These wedges must be accurately located. If the wedges have superconductors attached, one can correct all of the magnetic field multipoles (both normal and skew) from $N = 1$ (dipole) to $N = 6$ (12 pole). This paper describes this method of correction as it pertains to the SSC dipole magnet. 9 refs., 5 figs., 3 tabs.

15796 **(UCID—21291) SLAC fixed mask thermal stress analysis.** Martin, R.W. (Lawrence Livermore National Lab., CA (USA)). 20 Nov 1987. Contract W-7405-ENG-48. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005237/JAW.

X-ray beams emerging from the bending and undulator magnets in the SLAC electron-positron storage ring (PEP) can impinge on the walls of tangential divertor channels. A water cooled fixed mask made of 6061-T6 aluminum is installed in the channel to absorb the heat from mis-steered beams. Beam impingement on the mask causes localized heating with resulting thermal stresses. The current design and operating conditions will result in a maximum temperature of 80°C with a peak effective stress of 24% of the material yield strength for a mis-steering of the bending magnet beam. A peak temperature of about 170°C and a peak effective stress equal to 58% of material yield occur in the case of combined bending magnet and undulator beam mis-steer.

15797 **Elementary design and scaling considerations of storage ring colliders.** Chao, A.W. (SSC Central Design Group, Berkeley, California 94720). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 1, 103-120(25 Feb 1987). (CONF-850771—).

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

This article is a compilation of some considerations encountered in the design of storage ring colliders. It consists of two chapters. The first chapter describes an approach to the collider design from a particular point of view at an elementary level. The second chapter discusses a few semi-empirical scaling properties in the collider parameters.

15798 **Introduction to the nonlinear dynamics arising from magnetic multipoles.** Michelotti, L. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 1, 236-287(25 Feb 1987). (CONF-850771—).

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

We derive a Hamiltonian describing transverse particle motion in a storage ring. After a transformation to "action-angle" variables we show how to apply Green's function techniques to do Lie transform perturbation theory on this Hamiltonian. Two examples are worked out to second order; (1) normal and skew quadrupole field errors and (2) normal sextupoles. A brief discussion of the single resonance term Hamiltonian includes derivations of the two invariants and calculation of the resonance width for one degree of freedom systems. Finally, we generalize Courant's treatment of modulational diffusion as an illustrative application of Chirikov's criterion to a multi-resonance problem.

15799 **Modes of storage ring coherent instabilities.** Wang, J. (NSLS, Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 1, 697-788(25 Feb 1987). (CONF-850771—).

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

Partial correlation of the phases of the oscillations of different particles in a storage ring occurs because of inherent beam fluctuations or external noise. The beam then generates electromagnetic fields with the characteristic frequency or its harmonics and the EM fields act back on the beam. This coupling induces a, so called, coherent frequency shift. If a constructive interaction between these two oscillations occurs, coherent instability results. First order, linear, interactions (between the beam and fields) will be discussed. They will be divided into two parts longitudinal and transverse modes of coherent instabilities. (AIP)

15800 **Introductory statistical mechanics for electron storage rings.** Jowett, J.M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *AIP (American Institute of Physics) Conference Proceedings;* **153**: No. 1, 864-970(25 Feb 1987). (CONF-850771—). Contract AC03-76SF00515.

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

These lectures concentrate on statistical phenomena in electron storage rings. A stored electron beam is a dissipative, fluctuating system far from equilibrium whose mathematical description can be based upon non-equilibrium statistical mechanics. Stochastic differential equations are used to describe the quantum fluctuations of synchrotron radiation which is the main cause of randomness in electron dynamics. Fluctuating radiation reaction forces can be described via stochastic terms in Hamilton's equations of motion. Normal modes of particle motion, radiation damping effects, quantum diffusion in single-particle phase space are all discussed in this statistical formalism. (AIP)

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 14454, 15259, 15371, 15392, 15722, 16201, 16375, 16375, 16376, 16376, 16582, 16600, 16651, 16761, 16762, 16874, 16940

15801 **(AEEW-M—2289) Nuclear data ND-6700 system for gamma spectroscopy at Winfrith.** Horton, K.D. (UKAEA Atomic Energy Establishment, Winfrith). Nov 1985. 85p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750858/JAW.

The ND-6700 is a computerised counting system for measuring and recording emissions from a wide range of radioactive sources. This system as used at Winfrith consists of a central dedicated minicomputer, two terminals, two printers, and four detectors with associated counting electronics. Samples may be counted and the resulting gamma-ray spectra stored in a data file for subsequent analysis using the system's software. This report describes the ND-6700 system in detail, and provides a series of instructions for its operation and documentation for user written software.

15802 **(AERE-M—3535) Boron diffusion - a feasibility study for the diffusion of boron from boron tribromide.** Berridge, D. (UKAEA Atomic Energy Research Establishment, Harwell. Instrumentation and Applied Physics Div.). Jan 1986. 28p. H.M. Stationery Office, London, price Pound 5.00.

The commissioning of a boron diffusion facility in the device processing laboratory is described. Aspects of the process schedules and the applicability of this technology to the fabrication of diffused junction semiconductor radiation detectors are discussed.

15803 **(AERE-MPD/NBS—322) Users guide to the HELIOS backscattering spectrometer (BSS).** Bunce, L.J. (comp.). (UKAEA Atomic Energy Research Establishment, Harwell. Materials Physics and Metallurgy Div.). Oct 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750977/JAW.

The BSS is a backscattering spectrometer installed on the Harwell 136 Mev electron linear accelerator, HELIOS. A general description of the instrument is given, along with the time of flight scales, and the run and sample changer control units. The sample environment, vacuum system and detectors of the BSS are described, as well as the preparation, starting and running of an experiment using the BSS.

15804 **(AERE-R—12278) Operational trials of a CR-39 neutron dosimetry system. Progress to January 1986.** Harrison, K.G.; Goodenough, R.J. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Sep 1986. 37p. H.M. Stationery Office, London, price Pound 5.00.

Although new work has generally reinforced the previous conclusions (1985), recent sheets of commercial grade CR-39 have exhibited both good neutron sensitivity, and low backgrounds, which, unlike those of earlier batches, have not increased with time. This improvement is believed to be associated with changes in the manufacturing process. In addition, this work has confirmed that a revised and simplified processing schedule produces equivalent results to the original processing schedule, and there are indications that further changes may improve the low-energy neutron re-

sponse without increasing the backgrounds. Some studies of the effect of time and environment on the neutron sensitivity and background in the plastic have been undertaken. These have shown that, although slow changes take place in the plastic with time and environment, simple precautions minimise these effects, and they are not a serious obstacle to the introduction of an operational dosimeter. The most important remaining problem is that of the acceptability of the poor angular response of a single planar detector, and the possible need for an operational dosimeter to use multiple detectors with different orientations.

15805 **(AERE-R—12463) Passive filter calculations for semiconductor drift chamber signal pulse processing.** Rawlings, K.J. (UKAEA Atomic Energy Research Establishment, Harwell. Instrumentation and Applied Physics Div.). Feb 1987. 21p. H.M. Stationery Office, London, price Pound 4.00.

With the signal current from a semiconductor drift chamber (SDC) approximated by a pseudo Gaussian function that is faithfully integrated by the pre-amplifier, the amplitude response and the time to restore to 1% of the peak reponse have been calculated for filters having one RC differentiator stage and m RC integrator stages where m=1 to 7. The pulse height deficit at short peaking times is sensitive to how quickly the signal current decreases after its peak value. For a given pulse height deficit the step noise decreases slightly with increasing m and the rate capability, based on the 1% restore times, goes through a maximum at m=4.

15806 **(BNL—40421) Aging effects in low pressure wire chambers containing TMAE.** Woody, C.L. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-871006—26). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002788/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

The effects of aging in multiwire proportional chambers operated at low pressure with gas mixtures containing TMAE has been studied in connection with their use as a form of readout for BaF_2 crystals in high rate environments. Aging was induced by uv light which simulated high radiation exposure to BaF_2 crystals. Measurements were made on the loss in gain as a function of the total charge removed from the anode wires under various operating conditions. The results indicate a considerable improvement over previous aging effects measured at atmospheric pressure.

15807 **(BNL—40486) Capacitive charge division in centroid finding cathode readouts in MWPCs.** Smith, G.C.; Fischer, J.; Radeka, V. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 5p. (CONF-871006—21). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003545/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

A technique is described in which the centroid of induced charge on cathode strips in a proportional chamber can be determined with reduced differential and integral nonlinearity, without increasing the number of readout channels. It is based on capacitive charge division from intermediate cathode strips to adjacent readout strips, and may be applied to a variety of position readout principles.

15808 **(CEGB-RD-TPRD/B—0817/R86) Reduction of background signal in bismuth germanate scintillators.** Lewis, T.A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1986. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750971/JAW.

Bismuth germanate (BGO) is one of several new scintillator materials developed in recent years. It has similar energy resolution (6-8%) to sodium iodide (NaI) but it is non-hygroscopic, has a much better Peak-to-Compton ratio and a stopping power about 2.3 times greater than NaI. For counting activated foils it represents an improvement on NaI for high efficiency counting where the resolution of a germanium spectrometer is not required. Two scintillators bought for this purpose were found to have a higher than expected background signal between 500 keV and 2 MeV which was traced to Bi207, an active isotope of bismuth with a 38 year half-life and not listed as occurring naturally. Reference to the manufacturer showed all crystals to be similarly contaminated. It is speculated that this active isotope arises from cosmic proton activation of associated lead in the ore from which the bismuth is extracted. Although not confirmed rigorously it has been shown that bismuth extracted from ore with a low lead content does not contain Bi207. Scintillators have been manufactured from uncontaminated material and reductions in the background signal of more than an order of magnitude have been achieved. This reduction will be of immediate benefit for monitoring nickel foils (fast flux monitors) activated in zero-energy reactors and should also permit the exploitation of other low probability reactions previously not thought to be feasible.

15809 **(CEGB-TPRD/B—0781/R86) Thermal neutron response of beryllium oxide and other thermoluminescence dosemeters.** Lewis, T.A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). May 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750972/JAW.

Measurements and calculations are reported of the response to thermal neutrons of several types of thermoluminescence dosemeter (TLD) which could be used for assessing the photon dose inside zero-energy graphite moderated reactors. To be useful, the TLDs must have a low response to thermal neutrons. It is difficult to measure the response of TLDs to thermal neutrons in a rigorous way since all sources of thermal neutrons have an associated radiation field generated by neutron captures in the thermalising or containment medium. The TLDs respond to this associated radiation field. To compensate for the uncertainty this introduces, two independent measurement techniques have been employed and supported by an approximate calculation. Consistent results have been obtained in all cases. Recommended values are given for the response to thermal neutrons for all materials studied. For BeO, CaF_2 and Al_2O_3 the results are applicable to any material of the same geometry and of reasonable commercial purity whereas for TLD700 (LiF) the response is expected to vary from batch to batch.

15810 **(DL/SCI/TM—50A) Simple UHV photodiode beam position monitor at the Daresbury SRS.** MacDowell, A.A.; Jones, S.J. (Daresbury Lab. (UK)). Sep 1986. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750846/JAW.

Details of the construction and performance of a UHV photodiode beam position monitor at the Daresbury Synchrotron Radiation Source, United Kingdom, are given.

15811 **(DOE/ER/40039—20) Advanced forward calorimetry for present and future colliders.** DiBitonto, D.; McIntyre, P.M.; Atac, M. (Texas A and M Univ., College Station (USA). Dept. of Physics; Fermi National Accelerator Lab., Batavia, IL (USA)). 14 Sep 1987. Contract AS05-81ER40039. 31p. (CONF-870739—14). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004930/JAW.

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

We propose to develop a compact, high density calorimeter to instrument the very forward region. The design is based on a warm liquid medium such as tetramethylpentane (TMP) or neopentane which is better suited to the expected high background conditions than conventional gas media. The calorimeter will be assembled in sealed units, which can then be placed compactly into a variety of configurations. The accompanying hybrid electronic readout is designed to operate at either 100 MHz or 1 GHz, depending on the specific collider application (Tevatron or SSC).

15812 **(DOE/ER/40124—14-L7) Status report on the University of Washington Superconducting Booster Accelerator Project.** Storm, D.W.; Corcoran, D.T.; Howe, M.A.; Lin, Q.X.; Rosenzweig, D.P. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1987. Contract AC06-84ER40124. 12p. (CONF-870955—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004119/JAW.

From 3. workshop on RF superconductivity; Argonne, IL, USA (14 Sep 1987).

The University of Washington Superconducting Booster Accelerator linac is described briefly, and the resonators and rf control system are described in more detail. Operating experience to date is reported, including acceleration of any oxygen beam and transporting it to a scattering chamber where some of its properties were studied through elastic scattering from a gold foil. 9 refs., 4 figs. (LEW)

15813 **(EFI—885(36)-86) Stabilization and calibration of hodoscope Cherenkov spectrometer.** Aleksanyan, A.S.; Voskanyan, A.V.; Gasparyan, A.O.; Ketikyan, A.Zh.; Petrosyan, A.Zh.; Pikhtelev, R.N. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700155/JAW.

A procedure of stabilization and control of parameter drift of a 70-channel Cherenkov spectrometer by means of analysis of reference signals generated by a nitrogen laser is described. All the reference signal are bound to a scintillation from an α-source pulse on a single reference element. The full cycle of stabilizing parameter acquisition together with their express processing makes 1 minute of the experiment time. Photomultiplier power supply drift of hundred volts and a 2 - 3 fold drift of the laser power lead to a change in the calculated energy less than 2%. 7 references, 4 figures.

15814 **(EFI—896(47)-86) Experimental set-up for measurements of Compton scattering cross section on light nuclei.** Aleksanyan, A.S.; Babayan, G.E.; Voskanyan, A.V. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700161/JAW.

The main units of an experimental set-up for the study of the forward scattering of photons on light nuclei are described. The characteristics of the pair spectrometer, recoil-nuclei detector and the system of multichannel Cerenkov spectrometer combined with a wide-gap spark chamber are presented. Operation of the set-up is automated as much as possible by means of the CAMAC software operating on-line with the Electronika-100/25 minicomputer. 11 references, 6 figures.

15815 **(EFI—907(58)-86) Modelling the spectra of (e,e/sup '/) process by means of the ErFI experimental setup.** Mkrtchyan, G.G.; Troshenkova, I.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700166/JAW.

A model-independent method for obtaining the data free of radiative and instrumentation distortions is developed using the experimental results measured with the ErFI setup on the base of modelling the (e, e') spectra. 5 references, 1 figure.

15816 **(EFI—919(70)-86) Measurements of charged particle coordinates by a multiwire dielectric detector.** Gasparyan, S.G.; Gukasyan, S.M.; Kavalov, R.L.; Papyan, G.A.; Parlakyan, L.K.; Chubaryan, G.G. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700171/JAW.

The position sensitivity of a multiwire dielectric detector of particles is investigated. It is shown that the delay coincidence method may be succesfully used for measurement of the coordinates of charged particles by the multiwire dielectric detector with spacing of 0.5 mm. 8 references, 2 figures.

15817 **(FNAL/C—87/199) Operational experience with a high speed video data acquisition system in Fermilab experiment E-687.** Baumbaugh, A.E.; Knickerbocker, K.L.; Baumbaugh, B.; Ruchti, R. (Fermi National Accelerator Lab., Batavia, IL (USA); Notre Dame Univ., IN (USA)). 21 Oct 1987. Contract AC02-76CH03000. 5p. (CONF-871006—31). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004038/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

Operation of a high speed, triggerable, Video Data Acquisition System (VDAS) including a hardware data compactor and a 16 megabyte First-In-First-Out buffer memory (FIFO) will be discussed. Active target imaging techniques for High Energy Physics are described and preliminary experimental data is reported.. The hardware architecture for the imaging system and experiment will be discussed as well as other applications for the imaging system. Data rates for the compactor is over 30 megabytes/sec and the FIFO has been run at 100 megabytes/sec. The system can be operated at standard video rates or at any rate up to 30 million pixels/second. 7 refs., 3 figs.

15818 **(IAE—4302/11) NOKIA LP-4900 analyzer multiscaler mode without using the LPH-4913 standard unit.** Sinyanskij, O.V.; Avaev, A.V.; Artem'ev, A.N.; Krupin, S.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700601/JAW.

Additional software and modification of the electronic circuit of the NOKIA LP-4900 analyzer allowing to perform the multiscaler mode without using the appropriate stadard LPH-4913 unit, which, as a rule, is not a part of the standard analyzer set, are described. Besides, modification gives the possibility, being absent before, to control the analyzer by means of external signals, as well as to control the external devices according to the analyzer commands. Application of the modified analyzer in the experiment on simulation of computer tomography is considered. 5 figs.

15819 **(IFVE-OEA—86-12) Modules of nanosecond logic electronics system with computer control.** Bushnin, Yu.B.; Denisenko, A.A.; Dunajtsev, A.F.; Leonenko, D.A.; Marchikhin, N.K.; Sen'ko, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700190/JAW.

Nanosecond electronics modules, namely fan-out, amplifier-discriminator, amplifier-shaper, logic units of three types and delays of two types, implemented according to the VECTOR standard are described. Parameters of the modules (thresholds, durations, number of permitted channels for inputs pulses) are changed either manually by switchers on the front panel or by commands from a computer. The modules provide high speed (up to 100 MHz) and delay of 6-10 nsec. The presence of direct and inverse outputs enables to realize different logic functions. 9 references, 7 figures, 2 tables.

15820 **(IFVE-OEIUNK—86-208) Some features of plastic streamer tube operation.** Guz, Yu.P.; Lapin, V.V.; Obraztsov, V.F.; Zaitsev, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700636/JAW.

In the framework of the construction of the DELPHI hadron calorimeter the properties of plastic streamer tubes with high resistivity cathodes and external pick-up electrodes have been investigated. The tube structure consists of an extruded PVC profile (PVC+10% CaCO/sub 3/), shaped as an open 8-cell element where 80 μ anode wires are stretched along. All the wires are soldered to the HV connector via damping resistors. A PVC cover is placed on the top of it to close the 8-tube element with the inner cross section 9x9 mm. Both the top cover and open profile are coated with graphite paint on the side facing the wires, acting as the resistive cathode of the device. The 8-tube element is inside an extruded PVC container. External pick-up electrodes (pads) are used to detect induced pulses, transmitted through the resistive cathode. Most of the tests were made with 1 m long tubes and normally with a gas mixture composed of Ar:C/sub 4/H/sub 10/=1:3. A possible method of improving their operation performances with the help of an additional "antistatic" cover is demonstrated. 8 refs.; 19 figs.

15821 **(IN2P3—87-01-Vol.2) Vol. 2: semiconductor detectors in particle physics.** Equer, B.; Primout, M. (eds.). (Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France)). 1987. 145p. (In French). (CONF-8509292—). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751393/JAW.

From 17. summer school of particle physics; Clermont-Ferrand, France (9 Sep 1985).

This volume includes two lectures on semiconductor detectors, their current use and their perspectives.

15822 (IN2P3—87-01-Vol.2, pp 1-55) **Semiconductor detector physics.** Equer, B. (College de France, 75 - Paris). 1987. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751393/JAW. (CONF-8509292—).

From 17. summer school of particle physics; Clermont-Ferrand, France (9 Sep 1985).

Comprehension of semiconductor detectors follows comprehension of some elements of solid state physics. They are recalled here, limited to the necessary physical principles, that is to say the conductivity. P-n and MIS junctions are discussed in view of their use in detection. Material and structure (MOS, p-n, multilayer, ..) are also reviewed.

15823 (IN2P3—87-01-Vol.2, pp 56-129) **Semiconductor detectors in high energy physics.** Primout, M. (CEA CEN Saclay, 91 - Gif-sur-Yvette, France. Dept. de Physique des Particules Elementaires). 1987. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751393/JAW. (CONF-8509292—).

From 17. summer school of particle physics; Clermont-Ferrand, France (9 Sep 1985).

The energy loss mechanism in solids is presented. Then large surface detectors and their applications to the charged multiplicity measurement. High spatial resolution detectors are studied together with their applications to the precise reconstruction of charged tracks. Devices coming from optical imaging such as CCD are briefly described. Some indications are given on radiation effects on semiconductor devices are given. Other applications such as silicon calorimeter, drift chambers photodiodes, ... are recalled. Some experiments using semiconductor detectors are presented together with some projects.

15824 **(INFN-LNF—86-41(P)) EAS with plastic streamer tubes and other gas detectors.** Battistoni, G.; Gustavino, C.; Ronga, F.; Torres, S. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1986. 9p. (CONF-8605320—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701062/JAW.

From HE-UHE behaviour of accreting X-ray sources; Vulcano, Italy (12 May 1986).

The feasibility of a very large array for extensive air showers using very cheap gas detectors such as plastic streamer tubes and resistive plate counters is discussed. The cost of these devices is a fraction of the cost of a scintillator.

15825 **(INFN-LNF—87-73(P)) Signal to noise ratio in superconducting tunnel junction as ionizing particle detectors.** Pace, S.; Celani, F.; Saggese, A.; Giorgi, A. (Istituto Nazionale di Fisica Nucleare, Frascati (Italy). Lab. Nazionale di Frascati). 1987. 9p. (CONF-870880—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701066/JAW.

From International superconductivity electronics conference; Tokyo, Japan (28 Aug 1987).

The reasons for the disagreement between expected and measured performances of Superconducting Tunnel junctions (STJ) used as high resolution nuclear detector are discussed. In particular, the optimization of signal to noise (S/N) ratio for devices having low and high tunnel probability (p) versus the bath temperature (T) and the front-end electronics used i.e. voltage and charge amplifier has been analyzed and discussed. Calculations have been done about the intrinsic recombination time versus T for some conventional superconducting materials. It was found the time for which the maximum of the voltage signal from STJ versus p and T occurs. It is shown that for a charge amplifier coupled to the STJ the S/N ratio indefinitely increases decreasing T.

15826 (INIS-BR—748, pp 91) **Evaluation of beta radiation dose absorbed in skin using $CaSO_4$: Dy ultra thin thermoluminescent detectors.** Rosa, L.A.R. da; Caldas, L.V.E. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro, Brazil; Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15827 (INIS-BR—748, pp 57) **X-ray position sensitive detectors.** Barbosa, A.; Craievich, A.F.; Gabriel, A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15828 (INIS-BR—748, pp 69) **Double-axis x-ray diffractometer for crystal characterization.** Rodrigues, A.R.D.; Mazzaro, I. (Parana Univ., Curitiba, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15829 (INIS-BR—748, pp 114) **Bremsstrahlung isochromatic spectroscopy in the Anderson model.** Frota, H.O. da; Oliveira, L.N. de. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15830 (INIS-BR—748, pp 149) **X-ray detection by photoacoustic effect.** D'Aguiar Neto, M.M.F.; Vargas, H. (Bahia Univ., Salvador, Brazil; Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15831 (INIS-BR—748, pp 57) **Dispersive EXAFS chamber with sagittal focusing monochromator.** Tolentino, H.C.N.; Rodrigues, A.R.D. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15832 (INIS-BR—910, pp 56) **Three-dimensional high-resolution NMR spectroscopy for homonuclear spin correlation.** Mareci, T.H.; Plant, H.D.; Cockman, M.D.; Brey, W.S. (Florida Univ., Gainesville, USA. Dept. of Radiology; Florida Univ., Gainesville, USA. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

15833 (INIS-BR—910, pp 54) **EPR dosimetry of travertines.** Lopes, C.E.; Bouchez, R.; Amosse, J.; Catalan, N. (Universidad Nacional de Ingenieria, Lima, Peru; Grenoble-1 Univ., 38, France; Grenoble-1 Univ., 38, France. Inst. Dolomieu de Geologie). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

15834 (INIS-BR—910, pp 54) **ESR dosimetry of bones exposed to environmental radiation.** Baffa, O.; Mascarenhas, S.; Fujimori, K.; Cardoso, A.J.; Soma, M. (Sao Paulo Univ., Brazil. Inst. de Fisica; Sao Paulo Univ., Brazil. Inst. Astronomico e Geofisico; Universidade Estadual de Campinas, Brazil; Instituto Butantan, Sao Paulo, Brazil). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

15835 (INIS-BR—910, pp 58) **Architecture of the Sao Carlos 2.0 Tesla NMR tomograph.** Tannus, A.; Torre Neto, A.; Martins, M.J.; Bonagamba, T.J.; Beckmann, N.; Slaets, J.F.W.; Panepucci, H.C. (Sao Paulo Univ., Sao Carlos, SP, Brazil. Inst. de Fisica e Quimica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

15836 (INIS-mf—11093, pp 55-57) **Lens operation mode of a superconducting magnet plus Si(Li) electron spectrometer.** Kibedi, T.; Gacsi, Z.; Krasznahorkay, A.; Nagy, S. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

15837 (INIS-mf—11093, pp 58-59) **Stable isotope mass spectrometer.** Hertelendi, E.; Gal, J.; Paal, A.; Fekete, S.; Gyoerffi, M.; Gal, I.; Kertesz, Zs.; Nagy, S. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

15838 (INIS-mf—11093, pp 64) **Multi-counter measuring system for /sup 14/C dating.** Hertelendi, E.; Csongor, E.; Zaborszky, L.; Molnar, J.; Gal, J.; Juhasz, K.; Nagy, S. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

15839 (INIS-SU—431, pp 524) **Units for X-ray and low-energy γ detection on the base of semiconductor detectors.** Lupilov, A.V.; Danengirsh, S.G.; Zalinkevich, V.A.; Slyusar', Yu.G.; Sokolov, A.D. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

15840 (INIS-SU—431, pp 526) **System for stabilizing scintillation detectors in a low-background device.** Bondarenko, O.A.; Zdesenko, Yu.G.; Kostezh, A.B.; Kropivyanskij, B.N.; Nikolajko, A.S. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

15841 (INIS-SU—431, pp 527) **On the systematic errors in evaluation of antineutrino mass from tritium β decay.** Pokrovskij, V.N.; Prostakov, I.A.; Vylov, Ts.; Chistyakov, V.P. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

15842 (INIS-SU—431, pp 528) **System for studying Xγ coincidence spectra.** Begzhanov, R.B.; Azimov, K.Sh.; Gladyshev, D.A.; Magrupov, R.D.; Mirakhmedov, Sh.A.; Mukhammadiev, A.; Narzikulov, M.; Salimov, S.Kh. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

15843 (INIS-SU—431, pp 529) **Calculating the probabilities of (n-γ) identification errors for identifying filters with arbitrary weighting function.** Korsakov, D.B.; Matyukov, A.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

15844 (INIS-SU—431, pp 417) **Measuring and calculational complex for studying angular γ-γ-correlations in the A(x,y,γ)B reactions.** Lebedev, V.M.; Ignatenko, A.V.; Orlova, N.V.; Spasskij, A.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

15845 (INIS-SU—431, pp 585) **Specific features of backscattering spectrometry of samples with large luminescence.** Zavodchikov, V.M.; Sokhoreva, V.V.; Yatis, A.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

15846 (INIS-SU—431, pp 522) **Spectrometric performances of the (e-γ) coincidence magnetic lens spectrometer system for on-line experiments.** Abrosimov, V.N.; Krupa, Eh.; Morozov, V.A.; Tan'ska-Krupa, V.; Khudajberdyev, Eh.; Razov, V.I. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

15847 (INIS-SU—431, pp 525) **Low-background system for studying rare processes.** Bondarenko, O.A.; Vasilenko, V.V.; Gar'kusha, G.N. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

15848 (INIS-SU—431, pp 415) **Comparative analysis of characteristics of BGO and NaI(Tl) crystals when detecting γ quants and neutrons.** Kamanin, V.V.; Kugler, A.; Sobolev, Yu.G.; Fomichev, A.S. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

15849 (INIS-SU—431, pp 523) **X-ray and γ detectors on the base of high-purity germanium.** Voronov, I.N.; Danengirsh, S.G.; Zatoloka, S.I.; Podkopaev, O.I.; Prokhorov, S.B. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

15850 (INIS-SU—431, pp 536) **Computerized system for identification and spectrometry of charged particles in high-intense pulsed beams.** Pugach, V.M.; Pavlenko, Yu.N.; Gass, A.S. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

15851 (INIS-SU—431, pp 587) **Application of microtron secondary radiations for determination of recording efficiency for total absorption peaks and N-fold escape.** Stets, M.V.; Ryabinichev, S.P.; Sikora, D.I. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

15852 (IPEN-Pub—114) **Thermoluminescent properties of $Li_2B_4O_7$: T/sub m/.** Rzyski, B.M.; Morato, S.P. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Jul 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700245/JAW.

With the aim to develop a material which shows the necessary properties for the production of a solid state radiation dosemeter, thulium, (Tm), activated lithium tetraborate, ($Li_2B_4O_7$), was studied. This material shows a thermoluminescent, (TL), effect and was produced in polycrystalline and glassy forms. The optimum impurity concentration was determined to be 2%, by weight. Glassy $Li_2B_4O_7$: Tm showed more resistance to radiation damage, and its TL sensitivity is about four and half times lower than the polycrystalline form. The TL emission spectrum has a dominant peak at 445nm which falls into the useful photomultiplier detection interval of the common commercial TL readers. The TL glow curves consist of three peaks for polycrystalline and glassy samples. Some of the polycrystalline $Li_2B_4O_7$: Tm TL characteristics are: a)activator emission spectrum lies into the common commercial PM detection spectrum range, b)dosimetric peak at 288°C, c)linear TL output in the 0.1mGy-10^3 Gy dose range, d)post irradiation fading at ambient temperature less than 10% in three months.

15853 (IPEN-Pub—120) **$CaSO_4$: Dy + Teflon dosimetric pellets for X, beta and gamma radiation detection.** Campos, L.L.; Lima, M.F. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Aug 1987. 12p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700247/JAW.

$CaSO_4$: Dy + TEFLON dosimetric pellets with high sensitivity and low cost for X, beta and gamma radiation monitoring were studied and developed by the Dosimetric Material Production Laboratory of the Radiological Protection Departament and are disposable for sale. The thickness of the pellets are suitable for X, beta and gamma radiation measurements. The dosimetric properties of these pellets were determined and presented in this work. The results show the usefulness of 0,20mm thick pellets for beta radiation monitoring and 0,80mm thick pellets for x and gamma radiation detection.

15854 (ITEF—104(1985)) **Test system for wire chambers.** Burov, S.I.; Klimentov, A.A.; Korzhavin, I.A.; Kutsenko, V.A.; Semenov, Yu.A.; Fedotov, O.P.; Shvachkin, V.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700251/JAW.

A test system for wire chambers (TSC) of a hadron uranium calorimeter is decribed. The system is a computer complex on the basis of the Electronika-60 microcomputer. The TSC provides data readout, monitoring and initial processing, tape and disc recording, chamber testing control and a number of auxiliary functions. The TSC is operated via the RT-11V5.0 operating system. The computer complex configuration and schematic description of the system are presented. The software structure is considered and the TSC computer codes directly related to data acquisition and processing. The service functions of the system are proposed as user's manual. 3 references, 3 figures.

15855 (ITEF—176(1985)) **DIALOG program package for on-line physical experiments with the ES1010 computer.** Degtyarenko, P.V.; Druzhinin, B.P.; Zagreev, B.V.; Kosov, M.V.; Fominykh, B.A.; Shuvalov, S.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 63p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700253/JAW.

Dialog program package for the ES1010 computer aimed at real time control of electronic equipment, organizing data reception, data processing is described. The program package implementation in the Nonmagnetic Hadron Spectrometer (IHEP) for multichannel configuration is considered. These data can be used to develop the program system ensuring other experimental facility operation on-line with the ES1010 computer. 12 references, 3 figures.

15856 (JINR—13-86-813) **Cylindrical multiwire two-coordinate chamber operating in self-quenching streamer mode utilizing a polyurethane foam pipe support.** Vakhtin, V.G.; Travkin, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700259/JAW.

Submitted to the journal Instrum. Exp. Tech.

A cylindrical multiwire 2-coordinate chamber operating in the self-quenching streamer mode has been constructed, utilizing a polyurethane foam pipe support, for detecting recoil particles in experiments at IHEP. The polyurethane foam pipe is coated with an epoxy compound ≲0.5 mm. The inductive electrode consists of a set of wire rings 0.25 mm in diameter embedded in circular grooves, cut around the polyurethane foam pipe, and soldered to a metal-clad fiberglass plate. The anode and carthode wires, 0.05 mm and 0.1 mm in diameter respectively, are mounted on fiberglass rings. The amount of substance in the path of particles is ≲0.2 g/cm^3. The chamber was tested with radioactive source, as well as in the accelerator beam, and operated for data accumulation during runs of the experiment on radiative scattering of negative pions and kaons on protons, in which a hydrogen target was utilized. The tests confirmed the correctness of the technological an design solutions adopted. 12 references, 3 figures.

15857 (JINR—E-11-87-10) **Some questions of using coding theory and analytical calculation methods on computers.** Nikityuk, N.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700905/JAW.

Main results of investigations devoted to the application of theory and practice of correcting codes are presented. These results are used to create very fast units for the selection of events registered in multichannel detectors of nuclear particles. Using this theory and analytical computing calculations, practically new combination devices, for example, parallel encoders, have been developed. Questions concerning the creation of a new algorithm for the calculation of digital functions by computers and problems of devising universal, dynamically reprogrammable logic modules are discussed. 14 refs.; 6 figs.

15858 (JINR—R-10-87-1) **Software of autonomous system for spectrometric measurements.** Brudanin, V.B.; Vylov, Ts.; Pichits, V.I.; Sidorov, V.T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700929/JAW.

The organization of hardware and software for the off-line system of acquisition, accumulation and preliminary processing of spectrometric data is described. The system is based on the KM001 microcomputer and CAMAC equipment. The configuration and structure flowchart of the system are given. Programs allowing one to acquisite numerical data from the spectrometers, to search for instrumental spectra, visual presentation and preliminary processing of spectrometric data are briefly described. 11 refs.; 1 fig.; 1 tab.

15859 **(LA—11133-MS) Comparison of calculated and measured response functions for germanium detectors.** Streetman, J.R.; Moss, C.E. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005115/JAW.

This report compares calculated and measured germanium spectra for ^{65}Zn, ^{137}Cs, and ^{113}Sn sources and uranium and plutonium spherical shells. Agreement over the full energy range of the spectra is good; deviations are explained.

15860 **(LAL—87-12) Design and rejection studies for a cylindrical transition radiation detector for the UA2 upgrade.** Ansari, R.; Chollet, J.C.; De Lotto, B.; Froidevaux, D.; Fayard, L.; Merkel, B.; Iconomidou-Fayard, L.; Moniez, M.; Parrour, G.; Repellin, J.P. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Mar 1987. 17p. (CONF-8605164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751411/JAW.

From 2. topical seminar on perspectives for experimental apparatus at future high energy machines; San Miniato, Italy (5 May 1986).

A study of a compact and cylindrical transition radiation detector is described. A prototype has been built and tested with 40 GeV electrons and hadrons. The measurements have been done using 100 Mhz FADC. We have compared different radiators and chamber geometries using various algorithms. The cluster counting and the total integrated charge methods give comparable results. A comparison between radiators of lithium and polypropylene is made.

15861 **(LAPP-EXP—87-02) Superheated superconducting granules: a detector for particle physics and astrophysics.** Gonzalez-Mestres, L.; Perret-Gallix, D. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Jan 1987. 19p. (CONF-8701104—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751419/JAW.

From International school on astro-particle physics; Erice, Italy (5 Jan 1987).

A general introduction to superheated superconducting granules (SSG) detectors is given and some recent results on their basic properties are presented. Granules recently made by industrial producers exhibit good metastability properties and show sensitivity, better than naively expected, to photons and ionizing particles. The behaviour of SSG detectors at very low temperatures is also discussed. We finally sketch a critical review of proposed applications to the cross-disciplinary frontier between particle physics and astrophysics.

15862 **(LBL—23104) Magnetic measurement system for harmonic analysis of LBL SSC [Superconducting Super Collider] model dipoles and quadrupoles.** Green, M.I.; Barale, P.J.; Gilbert, W.S.; Hassenzahl, W.V.; Nelson, D.H.; Taylor, C.E.; Travis, N.J.; Van Dyke, D.A. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 5p. (CONF-870901—19). NTIS, PC A02. Order Number DE88003907/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

Specialized hardware and software have been developed to facilitate harmonic error analysis measurements of one-meter-long Superconducting Super Collider (SSC) model dipole and quadrupole magnets. Cold bore measurements feature cryogenic search-coil arrays with high bucking ratios that also have sufficient sensitivity to make room-temperature measurements at the low magnet currents of ~10 A. Three sets of search coils allow measurements of the center, either end, and/or the axially integrated field. Signals from the search coils are digitally integrated by means of a voltage-to-frequency converter feeding an up-down counter. The data are drift corrected, Fourier analyzed, converted to physical quantities, and printed and plotted. A cycle of measurements including data acquisition, processing, and the generation of tabular and graphic output requires 80 seconds. The vast amount of data generated (several hundred measurement cycles for each magnet) has led to the development of postprocessing programs and procedures. Spreadsheets allow easy manipulation and comparison of results within a test series and between magnets. 8 refs., 4 figs., 1 tab.

15863 **(LBL—24302) Cryogenic detectors of particles: Hopes and challenges.** Sadoulet, B. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 9p. (CONF-871006—29). NTIS, PC A02. Order Number DE88004553/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

We review the various methods proposed for cryogenic detection of particles, the current status of their development and their potential applications. 42 refs., 11 figs., 1 tab.

15864 **(LPC—86-09) Photosensitive gas detectors for the ring-imaging Cherenkov (rich) technique and the Delphi barrel rich prototype.** Arnold, R.; Berst, J.D.; Baillon, P. (College de France, 75 - Paris. Lab. de Physique Corpusculaire). Feb 1986. 34p. (CONF-860272—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751758/JAW.

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

After a short introduction to the ring-imaging technique, the principal types of photosensitive gas detectors are discussed. In the second part, status and results of the DELPHI barrel RICH prototype are presented. A short description of a possible very fast RICH for future hadron colliders is given.

15865 **(PB—88-123708/XAB) NBS (National Bureau of Standards) measurement services: radioactivity calibrations with the 4 pi gamma ionization chamber and other radioactivity calibration capabilities. Special pub. (Final).** Calhoun, J.M. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Oct 1987. 45p. (NBS/SP—250/10). NTIS, PC A03/MF A01.

Also available from Supt. of Docs. as SN003-003-02824-0. See also PB—88-123781, and PB—88-123690; Library of Congress catalog card no. 87-619870.

The paper describes the use of the NBS 4 pi' gamma ionization chamber - an instrument which provides an indirect method of comparing the activity (decays per second) of gamma-ray-emitting radionuclides with national standards for a routine calibration service by the National Bureau of Standards Radioactivity Group. A description of the chamber's construction and characteristics, the operational procedure, and the associated equipment is included. A description of NBS capabilities for direct radioactivity calibrations is also presented. Many of these capabilities are used to establish calibration factors for the 4 pc gamma ionization chamber.

15866 **(PB—88-124425/XAB) NBS (Nationnl Bureau of Standards) large-area alpha-particle counting systems.** Hutchinson, J.M.R.; Bright, S.J. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). 1987. 14p. NTIS, PC A04/MF A01.

Included in Jnl. of Research of the National Bureau of Standards, Vol. 92, No. 5, 311-324(Sep-Oct 1987).

Two alpha-particle counting systems for the measurement of large-area sources were developed at the National Bureau of Standards. The systems and their characteristics are described. One system uses an internal-source proportional counter and the other measures sources external to the counting volume through a thin aluminized mylar window. The internal system is used to measure sources in the lower-activity ranges. These calibrated sources are then used to establish the efficiency of the external counter used to measure the higher-activity sources.

15867 **(PNL-SA—14935) Use of low-background germanium detectors to preselect high-radiopurity materials intended for constructing advanced ultralow-level detectors.** Arthur, R.J.; Reeves, J.H.; Miley, H.S. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 14p. (CONF-871006—39). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005136/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

Measurements using a highly sensitive multidimensional counting system were made on commercially available components to identify materials of high radiopurity. Currently, three germanium spectrometer systems of unusually low background have been

constructed using these components. Additional measures employed to achieve a low system background are: (1) carefully selecting shielding materials; (2) locating the detector underground and/or using an active external anticosmic shield to reduce the background continuum due to cosmic-particle interactions within the detector; the passive bulk shielding, and the sample mass; (3) using a special solder composition; (4) shielding the preamplifier electronics from the diode; and (5) exhausting nitrogen from the cryogenic dewar into the nearly airtight sample chamber to minimize the infusion of ubiquitous radon decay nuclei. One use of low-level detectors is to identify more accurately system component radiopurity for use in the construction of advanced ultralow-level detectors. The use of a well-type spectrometer would facilitate non-destructive measurements performed on small components not available in large quantities (modified field-effect transistors, etc.). A carefully designed low-level gamma-ray counting system will have a system background, relative to other typical low-background systems, lower by a factor of ten or more below one MeV and by a factor of forty or more at higher energies. Such germanium-diode gamma-ray spectrometers may be constructed for a modest investment above that required for a conventional germanium detector.

15868 **(RAL—86-064) Two digital X-ray imaging systems for applications in X-ray diffraction.** Bateman, J.E.; Connolly, J.F.; Stephenson, R.; Flesher, A.C.; Bryant, C.J.; Lincoln, A.D.; Tucker, P.A.; Swanton, S.W. (Rutherford Appleton Lab., Chilton (UK)). Aug 1986. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750854/JAW.

Two digital X-ray imaging systems developed at the Rutherford Appleton Laboratory are described:- the Mark I and the Mark II. Both use a bidimensionally sensitive Multiwire proportional counter as the basic X-ray image transducer coupled to a digital microcomputer system. The Mark I system provides the advantages of high speed, high sensitivity digital imaging directly into the computer with the potential for software control of the sample orientation and environment. The Mark II system adds the novel features of signal averaging and multi-frame exposures.

15869 **(RAL—86-077) Vertex detectors - lectures presented at the Advanced Study Institute on techniques and concepts of high energy physics, St. Croix, June 1986.** Damerell, C.J.S. (Rutherford Appleton Lab., Chilton (UK)). Jul 1986. 111p. (CONF-8606356—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750853/JAW.

From Advanced Study Institute on techniques and concepts of high energy physics; St. Croix, France (1 Jun 1986).

High precision vertex detectors can be used to identify the decay products of parent particles which have lifetimes of the order 10^{-13} seconds. The paper summarises the performance achieved by a variety of techniques, and proceeds to a detailed discussion of the current status and potential of silicon detectors for high precision tracking.

15870 **(RAL—86-078) Intense transmission spectrometer for ISIS.** Newport, R.J.; Howells, W.S. (Rutherford Appleton Lab., Chilton (UK)). Jul 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750906/JAW.

The report seeks to outline a design for an intense transmission spectrometer (ITS) suitable for installation on the pulsed neutron source ISIS. The performance of the instrument is evaluated and several examples of the areas of science made accessible are discussed. It is shown that the proposed design will represent a scientifically valuable and cost-effective addition to the present suite of ISIS instruments.

15871 **(RI—179) Stability of pulse amplitude of spectroscopic shapers with time-independent parameters.** Malkin, A.L.; Sheremet'ev, A.K. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700281/JAW.

Pulse amplitude instability in a spectrometer defined both by instability of element parameters composing the shaper and by the change of edge duration in amplifying cascades is considered. The analysis is performed by Fourier transformation. The results of analysis are confirmed by experimental data. It is shown that amplitude instability 10^{-5} per degree can be obtained using stable elements. 2 references, 2 figures.

15872 **(SLAC—322) Design and construction of a Vertex Chamber and measurement of the average B-Hadron lifetime.** Nelson, H.N. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00515. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004493/JAW.

Four parameters describe the mixing of the three quark generations in the Standard Model of the weak charged current interaction. These four parameters are experimental inputs to the model. A measurement of the mean lifetime of hadrons containing b-quarks, or B-Hadrons, constrains the magnitudes of two of these parameters. Measurement of the B-Hadron lifetime requires a device that can measure the locations of the stable particles that result from B-Hadron decay. This device must function reliably in an inaccessible location, and survive high radiation levels. We describe the design and construction of such a device, a gaseous drift chamber. Tubes of 6.9 mm diameter, having aluminized mylar walls of 100 μm thickness are utilized in this Vertex Chamber. It achieves a spatial resolution of 45 μm, and a resolution in extrapolation to the B-Hadron decay location of 87 μm. Its inner layer is 4.6 cm from e^+e^- colliding beams. The Vertex Chamber is situated within the MAC detector at PEP. We have analyzed botht he 94 pb^{-1} of integrated luminosity accumulated at $\sqrt{s} = 29$ GeV with the Vertex Chamber in place as well as the 210 pb^{-1} accumulated previously. We require a lepton with large momentum transverse to the event thrust axis to obtain a sample of events enriched in B-Hadron decays. The distribution of signed impact parameters of all tracks in these events is used to measure the B-Hadron flight distance, and hence lifetime. 106 refs., 79 figs., 20 tabs.

15873 **(SLAC-PUB—4403) Lorentz angle studies for the SLD endcap Cerenkov Ring Imaging Detector.** Coyle, P.; Cavalli-Sforza, M.; Coyne, D.; Schneider, M.; Spencer, E.; Williams, D.; Ashford, V.; Bienz, T.; Bird, F.; Gaillard, M. (California Univ., Santa Cruz (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA); California Univ., Santa Barbara (USA); Cincinnati Univ., OH (USA)). Nov 1987. Contract AT03-76ER70023;AC03-76SF00515. 6p. (CONF-8709153—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004383/JAW.

From Conference on position-sensitive detectors; London, UK (7 Sep 1987).

The design of the endcap Cerenkov Ring Imaging Detectors for SLD requires a detailed understanding of how electrons drift in gases under the influence of crossed electric and magnetic fields. In this report, we present recent measurements of Lorentz angles and drift velocities in gases suitable for the endcap CRID photon detectors. We compare these measurements to predictions from a theoretical model; good agreement is observed. Based on our results we present a design for detectors operating in a 0.6 Tesla transverse magnetic field. 14 refs., 10 figs., 4 tabs.

15874 **(SLAC-PUB—4418) Design and fabrication of advanced hybrid circuits for high energy physics.** Haller, G.M.; Moss, J.; Freytag, D.R.; Nelson, D.; Yim, A.; Lo, C.C. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00515. 6p. (CONF-871006—22). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004392/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

Current design and fabrication techniques of hybrid devices are explained for the Drift Chamber and the Liquid Argon Calorimeter for the Stanford Linear Collider Large Detector (SLD) at SLAC. Methods of developing layouts, ranging from hand-cut templates to advanced designs utilizing CAD tools with special hybrid design software were applied. Physical and electrical design rules for good yield and performance are discussed. Fabrication and assembly of the SLD hybrids are described. 7 refs., 10 figs.

15875 (SLAC-PUB—4452) Status of the silicon strip vertex detector for the Mark II experiment at the SLC. Adolphsen, C.; Gratta, G.; Litke, A.; Schwarz, A.; Turala, M.; Breakstone, A.; Parker, S.; Barnett, B.; Dauncey, P.; Drewer, D. (California Univ., Santa Cruz (USA). Inst. for Particle Physics; Hawaii Univ., Honolulu (USA); Johns Hopkins Univ., Baltimore, MD (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00515;AA03-76SF00034;AC03-83ER40103. 5p. (CONF-871006—30). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004626/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

We are constructing a silicon strip vertex detector to be used in the Mark II detector in the study of Z^0 decays at the SLAC Linear Collider. The status of the project, including the performance of the individual silicon detector modules, is presented. 6 refs., 8 figs., 2 tabs.

15876 (SLAC-PUB—4457) Report on the non-magnetic detector group. Akesson, T.; Fabjan, C.W.; Cahn, R.N.; Klopfenstein, C.; Madaras, R.J.; Ronan, M.T.; Stevenson, M.L.; Strovink, M. (European Organization for Nuclear Research, Geneva (Switzerland); Lawrence Berkeley Lab., CA (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA); Columbia Univ., New York (USA); Northern Illinois Univ., Dekalb (USA); California Univ., Santa Cruz (USA)). Oct 1987. Contract AC03-76SF00515;AC03-76SF00098. 19p. (CONF-870739—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004391/JAW.

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

This report presents a model of a detector for use in the superconducting supercollider (SSC). By employing a combination of track-matching, calorimetric, longitudinal and transverse shower profile measurements, and transverse radiation detector information, the detector is capable of superior electron identification. It has an excellent muon identification and measurement system, and it allows the use of an optimized calorimeter that is not compromised by the requirements of a large magnetic field. The authors conclude that a non-magnetic detector is a strong candidate for a 4pi SSC detector for the study of high-mass phenomena. 23 refs., 14 figs., 3 tabs.

15877 (TPRD/B—0827/R86) Measurement of the response to fast neutrons of several materials dosemeters. Jones, L.T.; Kitching, S.J.; Lewis, T.A.; Playle, T.S. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750322/JAW.

The response to fast neutrons was measured for three types of materials testing dosemeters: fast neutron dosimetry silicon diodes; beryllia, alumina and calcium fluoride TLDs; graphite walled ionisation chambers. The calibrations were made using a 3MW positive ion accelerator. The arrangement of the target, beam monitor and devices is described, and the measured fast neutron sensitivities are presented.

15878 (TRI-PP—86-75-10/87) A cylindrical drift chamber for the measurement of $K \rightarrow \pi$ nu anti nu. Cresswell, J.V.; Ahmad, S.; Blackmore, E.W.; Bryman, D.A.; Khan, N.; Kuno, Y.; Numao, T. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1987. 4p. (CONF-871006—36). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900278/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

A cylindrical drift chamber has been constructed for the study of the rare kaon decay $K+ \rightarrow \pi^+$ nu anti nu. Data from two prototype chambers and initial results from the final chamber are presented.

15879 (TRI-PP—87-74) The kaon factory: Toward the physics of strongly interacting systems. Vogt, E. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1987. 6p. (CONF-8709221—2). NTIS (US Sales Only), PC A02. Order Number DE88900277/JAW.

From Interactions and structures in nuclei conference; Sussex, UK (7 Sep 1987).

With the advent of the standard for quarks and leptons and unified forces there are profound new questions for the physics of strongly interacting systems: the nature of the nucleon, the physics of quark confinement, fundamental symmetries governing hadron decay and the effect of quarks and gluons on nuclear behavior. Of the new large facilities now planned to respond to these questions the kaon factory is central. It uses very intense ($\sim$100 μA) primary proton beams ($\sim$30 GeV) to generate intense secondary beams of various hadrons and leptons.

15880 (TRI-PP—87-84) Wire chamber ageing with CF_4/isobutane and argon/ethane mixtures. Henderson, R.; Openshaw, R.; Faszer, W.; Salomon, M.; Salomons, G.; Sheffer, G. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1987. 6p. (CONF-871006—40). NTIS (US Sales Only), PC A02. Order Number DE88900273/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

Using several identical test cells, we have investigated the ageing charcteristics of CF_4/Isobutane (80:20) and Argon/Ethane (50:50). The gas gain and gas flow rate were varied and the measurements extended beyond 6 Coulomb/cm of wire (C/cm). Study of a third gas mixture Ar/Eth/CF_4 (48:48:4) is at an early stage. The Ar/Eth mixture has shown a variety of problems including cathode foil etching, anode deposits, dark currents and pulse height degradation. In contrast the CF_4/Iso mixture produced some cathode etching for low flow velocities and only very minor anode deposits. With very little pulse height degradation or dark current this mixture is an excellent candidate for a high rate chamber. A small area MWPC using this mixture has been evaluated in a pion beam with particle fluxes up to 3 x 10^7 particles/cm^3-sec.

15881 (UCRL—97732) A compact beam position monitor for use inside a Free Electron Laser wiggler. Kulke, B.; Shay, H.; Coffield, F.; Frye, R.; Holmes, R. (Lawrence Livermore National Lab., CA (USA)). 12 Nov 1987. Contract W-7405-ENG-48. 18p. (CONF-8709110—16). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004354/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

An all-aluminum, non-intrusive beam position monitor (BPM) with a 27-mm diameter, clear aperture is described, along with its associated electronics. The device is small enough to fit inside a Free Electron Laser (FEL) wiggler magnet as part of the beam pipe, and all signal leads are brought out horizontally to accommodate the wiggler geometry. A stripline configuration is used to allow precise mechanical construction and alignment of the probe electrodes, although the nominal 50-ns electron beam pulse length makes the electrical performance resemble that of a loop coupler. The large effective loop area generates nearly 0.5 V.ns/A of signal amplitude from each loop. The maximum beam current to be accommodated is 3 kA. The probes are spaced axially so as to be insensitive to the wiggling motion of the beam, and a special design feature allows the cancellation of signals due to direct charge interception from beam halo, and of x-ray Compton signals. Overall accuracy is expected to be better than 0.1 mm over a 2-mm diameter aperture, and 1 mm over a 20-mm diameter aperture. With gain control, the electronics channels have a 50-dB instantaneous dynamic range on the position signal. Hybrid junctions provide front-end differencing, and gated integrators allow sampling of different parts of the signal pulse. We have developed a procedure for separate calibration of position error components, such as the offset of the electrical from the mechanical axis and the electronics channel errors. An on-line calibration signal allows frequent recalibration of the electronics channel gains. After calibration, both fixed and variable errors are entered in the signal processing software and are used for real-time correction of the position signal. In this paper, bench test results are given for the first prototype BPM. 7 refs., 6 figs., 1 tab.

15882 Comparison between time-of-flight spectra measured at a spallation source and at a high flux reactor. Holland-Moritz, E.; Loewenhaupt, M.; Walter, U.; Loong, C. (II. Physikalisches Institut, Universitaet zu Koeln, 5000 Koeln 41, Federal Republic of Germany). *Review of Scientific Instruments;* 59: No. 2, 370-371(Feb 1988).

We give a comparison for inelastic neutron scattering experiments performed at the high flux reactor in Grenoble and at the spallation source in Argonne. These experiments were performed at the IN4 (I. L. L. Grenoble) and at the HRMECS (IPNS Argonne) with nearly identical conditions using $E_0 \simeq 50$ meV as energy of incident neutrons. We conclude that the neutron counting rate for a given scattering angle is less by a factor of about 30 at HRMECS than at IN4. This is due to a rather small neutron flux at HRMECS. Thus the background to signal ratio is worse by a factor of 2 at HRMECS compared to IN4.

15883 Conceptual design of a high-resolution π^0 spectrometer. Bowman, J.D. (Los Alamos National Laboratory). *AIP (American Institute of Physics) Conference Proceedings;* 163: No. 1, 119-143(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

The design of an updated version of the LAMPF based high-resolution π^0 spectrometer which is based upon the opening angle of the 2-gamma π/sup o/ radiative decay is presented. (AIP)

15884 Performance of a lead-glass spectrometer for detecting eta mesons. Peng, J.C.; Leitch, M.J.; Bowman, J.D.; Irom, F.; Kapustinsky, J.; Li, T.K.; Simmons, J.E.; Wong, Z.F.; Smith, C. (Los Alamos National Lab., NM, USA; Virginia Univ., Charlottesville, USA). *Nuclear Instruments and Methods in Physics Research;* 261: No. 3, 462-464(15 Nov 1987).

The characteristics of the LAMPF π/sup 0/ spectrometer for detecting $\simeq$ 100 MeV eta mesons are reported. Good solid angle acceptance and adequate energy resolution are achieved with this spectrometer.

15885 Waveshifter light collector for a water Cherenkov detector. Claus, R.; Sulak, L.; Ciocio, A.; Stone, J.L.; Seidel, S.; Casper, D.; Bionta, R.M.; Park, H.S.; Wuest, C.; Blewitt, G. (Boston Univ., MA, USA; Michigan Univ., Ann Arbor, USA; Boston Univ., MA, USA; Lawrence Livermore National Lab., CA, USA; California Inst. of Tech., Pasadena, USA). *Nuclear Instruments and Methods in Physics Research;* 261: No. 3, 540-542(15 Nov 1987).

A device has been developed which is capable of doubling the light collection capability of a 5 inch hemispherical photomultiplier tube. Known as a 'waveshifter plate', its geometry is adaptable to various applications. Its marginal cost is small with respect to that of a phototube, it is readily removable, and it has minimum effect upon dark noise and timing resolution.

15886 Use of a SiTek position sensitive detector for synchrotron radiation beam monitoring and alignment. Hanson, A.L.; Kwiatek, W.; Jones, K.W. (Brookhaven National Lab., Upton, NY, USA). *Nuclear Instruments and Methods in Physics Research;* 260: No. 2/3, 529-533(15 Oct 1987). Contract AC02-76CH00016.

A SiTek Laboratories one-dimensional position sensitive detector has been tested for use as a synchrotron radiation beam position monitor.

15887 Ionization and scintillation produced by relativistic Au, He and H ions in liquid argon. Shibamura, E.; Masuda, K.; Crawford, H.J.; Engelage, J.M.; Doke, T.; Hitachi, A.; Kikuchi, J.; Flores, I.; Lindstrom, P.J.; Ogura, K. (Saitama Coll. of Health, Urawa, Japan; California Univ., Berkeley, USA. Space Sciences Lab.; Waseda Univ., Tokyo, Japan. Science and Engineering Research Lab.; Lawrence Berkeley Lab., CA, USA; Nihon Univ., Narashino, Chiba. Coll. of Industrial Technology). *Nuclear Instruments and Methods in Physics Research;* 260: No. 2/3, 437-442(15 Oct 1987). Contract AC03-76SF00098.

We have measured ionization and scintillation produced by relativistic ions of Au, He and H in liquid argon. The sum of ionization signal and scintillation signal per unit energy deposition is the same for He and H ions, which is also the same as that for relativistic Ne, Fe and La ions previously measured. We have found that quenching occurs when liquid argon is irradiated by relativistic Au ions and that the sum per unit energy deposition for the Au ions is 70-76% of that for the other ions mentioned above.

15888 Pulsed holography for particle detection in bubble chambers. Akbari, H.; Bjelkhagen, H. (Tufts Univ., Medford, MA, USA. Dept. of Physics; Northwestern Univ., Evanston, IL, US. Dept. of Biomedical Engineering; Fermi National Accelerator Lab., Batavia, IL, USA). *Optics and Laser Technology;* 19: No. 5, 249-255(Oct 1987). Contract AC02-83ER40085.

For efficient detection of short-lived particles with lifetimes of the order of 10/sup -13/ s, bubble chambers must be equipped with high resolution imaging systems. Holography is such a technique, capable of achieving high resolutions over a large depth of field. In this report, a review of holography in bubble chambers is followed by a description of the dark-field holographic recording technique used in the 4.6 m (15-ft) bubble chamber at Fermilab. In this scheme, a high-power pulsed ruby laser, operating with an electro-optic feedback loop, was used as the light source. The laser was capable of producing light-pulses of duration of 2-100 μs with energies of about 8 J.

15889 Structure property correlation for CR-39 polycarbonate in dosimetry. Yang, C.S.; Davis, C.R.; Groeger, J.H.; Huang, S.J.; Johnson, J.F.; Hadlock, D.E.; Parkhurst, M.A. (Connecticut Univ., Storrs, USA. Inst. of Materials Science; Battelle Pacific Northwest Lab., Richland, WA, USA). *Nuclear Tracks and Radiation Measurements;* 12: No. 1-6, 547-550(1986). (CONF-850933—).

From 13. international conference on solid state nuclear track detectors; Rome, Italy (23 Sep 1985).

Commercial CR-39 monomers were distilled to a high degree of purity for the preparation of consistent polymers using a reliable initiator. The extent of polymerization and the degree of crosslinking were characterized by various techniques. Commercial and new CR-39 polymers were irradiated with high energy neutrons of various energies. The neutron tracks were developed by chemical and electrochemical etching processes followed by examination with an automatic image analyzer coupled with an interference microscope. A linear correlation of track density versus dosage was obtained in the 0-5 rem range. A preliminary study on a copolymer of CR-39 and maleic anhydride showed much higher etching velocity compared to CR-39 homopolymers, which may reduce track development time drastically.

15890 Semi-empirical model of neutron and charged particle interaction with CR-39. Parkhurst, M.A.; Hadlock, D.E.; Faust, L.G. (Pacific Northwest Lab., Richland, WA, USA). *Nuclear Tracks and Radiation Measurements;* 12: No. 1-6, 593-596(1986). (CONF-850933—).

From 13. international conference on solid state nuclear track detectors; Rome, Italy (23 Sep 1985).

The theory behind track detector response to neutrons is important to the calculation of dose equivalent, and the factors involved in track formation are diverse. The authors have envisioned a process by which individual parameters important to track interpretation would be identified, quantified, and categorized for use in model development and Monte Carlo calculations to establish dose equivalent algorithms. The paper focuses on just a few of the interactions under investigation in pursuit of empirical model development.

15891 Personnel neutron dosimetry using hot, low-frequency electrochemical etching. Hankins, D.E.; Homann, S.G.; Davis, J.M. (Lawrence Livermore National Lab., CA, USA). *Nuclear Tracks and Radiation Measurements;* 12: No. 1-6, 641-644(1986). (CONF-850933—). Contract W-7405-ENG-48.

From 13. international conference on solid state nuclear track detectors; Rome, Italy (23 Sep 1985).

The authors have developed an electrochemical-etch procedure for the processing of large numbers of CR-39 dosimeters. Specially designed Homann-Type chambers can etch up to 24 CR-39 chips, or foils, at one time. In the two-step procedure, the second step, called blow-up, increases the tracks' size and makes them relatively uniform. The energy response is fairly flat from ~ 150 keV to 4.5 MeV, but drops by about a factor of three in the 13-16 MeV range. The sensitivity of the dosimetry system is 6 tracks/mrem with a background of 8 mrem, giving a lower limit of sensitivity of approximately 10 mrem for the dosimeter. Because greater numbers of CR-39 foils can be accommodated at any one time, the procedure is quite efficient for operations with large numbers of dosimeters to be processed.

15892 **/sup 205/Tl experiment.** Henning, W.; Kutschera, W.; Ernst, H.; Korschinek, G.; Kubik, P.; Mayer, W.; Morinaga, H.; Nolte, E.; Ratzinger, U.; Mueller, M. (Argonne National Laboratory, Argonne, IL 60439, USA). *AIP (American Institute of Physics) Conference Proceedings;* **126**: No. 1, 203-211(25 Jan 1985). (CONF-8408132—). Contract W-31-109-ENG-38.

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

/sup 205/Tl has been previously proposed as a geological detector for solar neutrinos, making use of the reaction /sup 205/Tl(ν,e$^-$)/sup 205/Pb with a neutrino threshold of only ≅43 keV. We report on an experiment performed to study the feasibility of detecting radioactive /sup 205/Pb nuclei (T/sub 1/2/ = 15 million years) at very low concentrations using the recently developed technique of accelerator mass spectrometry. Empolying the high-energy ion beams of good quality from the UNILAC heavy-ion accelerator at the GSI Darmstadt, we are able to demonstrate a suppression of neighbouring isotopes to better than 1 in 10^{16} and of neighbouring elements to about 1 in 10^3. While these results are very encouraging, the minimum number of atoms detectable is still severely limited by the efficiency of producing mulitply-charged ions from present ion sources. Future improvements in ion-source performance are briefly discussed.

15893 **Homestake Large Area Scintillation Detector and cosmic ray telescope.** Cherry, M.L.; Corbato, S.; Kieda, D.; Lande, K.; Lee, C.K.; Steinberg, R.I. (Dept. of Physics, Univ. of Pennsylvania, Philadelphia, PA 19104). *AIP (American Institute of Physics) Conference Proceedings;* **126**: No. 1, 32-49(25 Jan 1985). (CONF-8408132—).

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

The Homestake Large Area Scintillation Detector consists of 140 tons of liquid scintillator in a hollow 8 m x 8 m x 16 m box surrounding the Brookhaven ^{37}Cl solar neutrino detector. The experiment is located at a depth of 4850 ft. (4200 m.w.e.) in the Homestake Gold Mine. Half of the detector is currently running; the full detector will be taking data early in 1985. An extensive air shower array is also currently under construction on the earth's surface above the underground chamber, consisting of 100 scintillators, each 3 m^2, covering approximately 0.8 km^2; the first portion of the surface array will also be providing data in early 1985. Together, the new Homestake detectors (Fig. 1) will be used to search for slow, massive magnetic monopoles; study the zenith angle distribution of neutrino-induced muons; search for neutrino bursts from the gravitational collapse of massive stars; measure the multiplicity and transverse momentum distributions of cosmic ray muons; and study the composition of the primary cosmic rays. In this paper, we present a progress report on the new detectors. In Sec. I we describe the underground device and its capabilities as a monopole detector; in Sec. II we describe the surface array and the cosmic ray studies; the neutrino measurements have been discussed elsewhere.

15894 **^{76}Ge double beta decay experiment at Homestake.** Brodzinski, R.L.; Brown, D.P.; Evans, J.C. Jr.; Hensley, W.K.; Reeves, J.H.; Wogman, N.A.; Avignone, F.T. III; Miley, H.S. (Pacific Northwest Laboratory, Richland, Washington 99352). *AIP (American Institute of Physics) Conference Proceedings;* **126**: No. 1, 50-59(25 Jan 1985). (CONF-8408132—). Contract AC06-76RL01830.

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

An ultralow background intrinsic Ge detector has been developed over several generations of experiments. The radioactive background from construction materials has been reduced by more than two orders of magnitude. The sources of background in a standard commercial cryostat have been identified and eliminated. Data taken with this 135 cm^3 prototype installed in the Homestake Gold Mine are presented. A large (1440 cm^3) detector and data acquisition system now under construction are also described.

15895 **Molybdenum solar neutrino experiment.** Wolfsberg, K.; Cowan, G.A.; Bryant, E.A.; Daniels, K.S.; Downey, S.W.; Haxton, W.C.; Niesen, V.G.; Nogar, N.S.; Miller, C.M.; Rokop, D.J.; and others. (Los Alamos National Laboratory, Los Alamos, New Mexico 87544). *AIP (American Institute of Physics) Conference Proceedings;* **126**: No. 1, 196-202(25 Jan 1985). (CONF-8408132—).

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

A method is described for measuring ^{98}Tc and ^{97}Tc produced by ^{8}B solar neutrino flux averaged over the past several million years. The chemical methods for handling and measuring the Mo and Tc are also discussed. (AIP)

15896 **Electronic detectors for the study of ^{8}B solar neutrinos (with sensitivity to energy and direction).** Chen, H.H. (Dept. of Physics, University of California, Irvine, CA 92717). *AIP (American Institute of Physics) Conference Proceedings;* **126**: No. 1, 249-276(25 Jan 1985). (CONF-8408132—).

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

The statistical requirement for any directional ^{8}B solar neutrino experiment with an initially large background to signal ratio (about 1000) indicates the need for extremely large detectors. However, this dector scale can be decreased substantially if the detector mass can be made radioactively clean so that only external backgrounds remain. Then the detector can be operated in a self-shielding mode. Among a number of detector options, the water Cherenkov approach being used in the search for proton decay satisfies these requirements. With the neutrino deuteron reaction via the use of heavy water rather than light water, the background to signal ratio can be further improved and one can demonstrate observation of the ^{8}B solar neutrino much before one can demonstrate its directionality.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

15897 **(AERE-R—12779) Effects of total dose on the SEU sensitivity of CMOS static RAMs.** Sanderson, T.K.; Mapper, D.; Stephen, J.H.; Farren, J. (UKAEA Harwell Lab. Instrumentation and Applied Physics Div.). Jul 1987. 69p. H.M. Stationery Office, London, price Pound 5.00.

Final report for the European Space Agency.

A study has been made of the effects of accumulated total dose on the single event upset (SEU) sensitivity of 4K x 1 CMOS static RAMs. This was performed by installing a /sup 252/Cf test system inside the LORAD low radiation test facility. The SEU measurements were made using the fission particles produced by a /sup 252/Cf source, whilst the total dose was accumulated by a continuous low dose rate irradiation with /sup 60/Co gamma rays, lasting eight months. The design and operation of the special memory test system are described in detail, together with the dosimetry and experimental procedures. In addition, several measurements and observations were made on the effects of accumulated total dose on CMOS SRAMs. Conclusions have been drawn on the

principal modes of failure and how these affect the susceptibility of the CMOS SRAMs to heavy ion induced single event upset.

15898 **(LAPP-EXP—87-01) Basic properties of superheated superconducting granules (SSG) detectors: irradiation results (α,γ) and very low temperature studies.** Gonzalez-Mestres, L.; Perret-Gallix, D. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Feb 1987. 5p. (CONF-870164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751418/JAW.

From 7. Moriond workshop: searches for new and exotic phenomena; Les Arcs, France (24 Jan 1987).

We present new results on the basic properties of superheated superconducting granules (SSG) detectors, concerning: a) Irradiation tests of Sn granules between 10 μm and 400 μm diameter with α,γ and beta minus sources at temperatures 1.4 K< T < 3.4 K. b). The behaviour of SSG at very low T (T ≧ 450 mK). New α irradiations confirm and further develop our previous results: a) Granules in the range 45 μm ≦ 0 (diameter) ≦ 400 μm exhibit metastability and turn out to be sensitive to α particles; b) the observed thresholds in applied magnetic field provide clear evidence for a local heating mechanism where the superconducting to normal (or intermediate state) phase transition starts before the whole granule is thermalized. Tests made at lower temperature (T ≧ 450 mK) show the absence of avalanche effect for several samples of Sn granules with about 10% filling factor in volume. We compare this result with the previously observed avalanches for Cd granules below 350 mK. We also present estimates on the behaviour of the detector at very low T, where a thin layer of normal electrons at the surface is shown to contribute to the heat capacity of a superheated granule. We finally briefly comment on some of the proposed experiments.

15899 **(UCRL—96219) Radiation effects on gallium arsenide integrated optical devices.** McWright, G.; Lowry, M.; Roeske, F.; Takeuchi, E.; Tindall, W.; Murphy, G. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 6p. (CONF-8708110—31). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004107/JAW.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

We discuss gallium arsenide integrated optical devices for high speed diagnostic systems. Specifically, we focus on the effect of radiation exposure on the performance characteristics of these devices. 7 refs., 7 figs.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 14003, 14022, 14133, 14183, 15016, 15255, 15305, 15655, 15661, 15993, 16035, 16125

15900 **(CEGB-TPRD/B—0905/R87) Development of a fast response thermocouple for use in liquid metals.** Morss, A.G.; Vincent, B. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Mar 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751465/JAW.

Work carried out at Berkeley Nuclear Laboratories to develop a fast-response thermocouple for use in liquid metals is described. This thermocouple because of its unique construction, has a junction mass approaching zero and hence its frequency response should be very high. Some of the problems of manufacture are discussed, in particular the high quality of seal required to avoid ingress of liquid metal. A comparison of results obtained with the fast-response thermocouple and with conventional stainless-steel-sheathed thermocouples is made. The improved response of the new thermocouple is clearly visible, hence confirming that measurements made with sheathed thermocouples suffer attenuation. It is concluded that results obtained with the fast-response thermocouple are close to the real magnitude of temperature fluctuations present in turbulent flow. It is also demonstrated that, with suitable corrections, results obtained with sheathed thermocouples can be used to estimate the real signals present in the flow.

15901 **(CONF-861015—3) Relating profile instrument measurements to the functional performance of rough surfaces.** McCool, J.I. (SKF Industries, Inc., King of Prussia, PA (USA)). 1986. Contract AC02-84ER13163. 7p. American Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017. Order Number TI88003923/JAW.

From Joint conference of the American Society of Lubrication Engineers and the American Society of Mechanical Engineers; Pittsburgh, PA, USA (19 Oct 1986).

An easily programmed method is proposed for translating the rms height (R/sub q/) and rms slope (Δq) determined using a profile measuring instrument, into more readily interpreted measures of functional severity such as the density of plastic contacts or the mean real contact pressure. The method involves estimation from the ratio R/sub q//Δq, of the exponent k of an assumed power function relation between the profile spectrum and the spatial frequency. Having estimated k, the mean square curvature is computed analytically and used together with R/sub q/ and Δq to determine the three input variables needed for the Greenwood-Williamson (GW) microcontact model. The GW model is then used to compute, as a function of the separation of two rough surfaces, the contact density, the plastic contact density, the mean load per unit area and the mean load per unit of real contact area. The mean square curvature estimated in this manner is compared to the directly measured mean square curvature for 12 distinct surface types. The values compared quite favorably (with 25%) for three of the specimens which included a bearing ball and the ground inner ring rolling path of a cylindrical roller bearing. The discrepancies exceeded a factor of 3 for three other specimens. The microcontact model output computed using both measured and estimated mean square curvature values showed that some output variables, e.g., plastic contact density, are more discrepant than the estimated and measured curvature values. Other output variables of the microcontact model, in particular, the mean real pressure, attenuate the discrepancies. The mean real pressures computed using the calculated and measured curvatures, were within 30% for all but three specimens. The maximum discrepancy observed was 55%. The results are sufficiently encouraging and the methodology so easy to apply, to commend the practice of routinely supplementing profile measurement data with microcontact model output.

15902 **(CONF-871255—1-Draft) Atom probe microanalysis: Principles and applications to materials problems.** Miller, M.K.; Smith, G.D.W. (Oak Ridge National Lab., TN (USA); Oxford Univ. (UK). Dept. of Metallurgy and Science of Materials). 1987. Contract AC05-84OR21400. 242p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88003768/JAW.

From Short course in materials science and technology; Boston, MA, USA (3 Dec 1987).

A historical background and general introduction to field emission and field-ionization, field-ion microscopy, and the atom probe is given. Physical principles of field ion microscopy are explained, followed by interpretation of images. Types of atom probes are discussed, as well as the instrumentation used in atomic probe microanalysis. Methods of atom probe analysis and data representation are covered, along with factors affecting performance and statistical analysis of atom probe data. Finally, some case studies and special types of analyses are presented. (LEW)

15903 **(CONF-880122—5) Johnson noise thermometer for high radiation and high temperature environments.** Oakes, L.C.; Shepard, R.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003770/JAW.

From 5. symposium on space nuclear power systems; Albuquerque, NM, USA (11 Jan 1988).

The purpose of development work on the Johnson noise power thermometer (JNPT) was to apply the work of Nyquist, who showed that the mean-squared noise voltage spectrum appearing across an unloaded resistor of value R is given by anti e/sub n/ ^{2} = 4hfR/[exp (hf/kT) - 1)] where anti e/sub n/^{2} has the units volts squared per unit frequency, and h and k are the Planck and Boltzmann constants, respectively, f is the frequency in hertz (Hz) and T is the absolute temperature in kelvins (K). J.B. Johnson showed that the noise was independent of the composition of the

resistor. These discoveries gave rise to a temperature measurement technique using the Johnson noise voltage and Johnson noise current in a noise power mode, which essentially gives immunity to the decalibrating effects of radiation-induced transmutations of the temperature-sensing element. Experiments have been conducted in which temperature measurements were made in the range from 300 to 1200°K. Extrapolation of plots of these data pass through absolute zero, as expected. In-pile irradiation experiments show no perceptible decalibration after 4500 h in high neutron flux even though 80% of the original sensor material, rhenium, had been transmuted to osmium.

15904 **(DOE/CE/30808—T2) A multi-channel, low velocity, hot film anemometry system for measuring air flows in buildings.** Guire, J.L. (Colorado State Univ., Fort Collins (USA). Dept. of Mechanical Engineering). 1987. Contract AC03-85CE30808. 135p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88004223/JAW.

A complete analytical and experimental development of a multichannel anemometry system is presented. The system consists of an array of low velocity sensors (0.0 m/s to 1.0 m/s), a constant current power supply, and the required data acquisition equipment. The velocity sensors can be scanned simultaneously yielding absolute air velocities and absolute ambient air temperatures at each of the probe positions in the array. One of the key results that this system can produce is the relationship between boundary layer flow and pressure driven flow through a large irregular aperture, such as a doorway, which up until now has been difficult to accomplish with regard to cost and experimental error incurred. 7 refs., 57 figs.

15905 (INIS-BR—748, pp 153) **Synthetic stratified microstructures for X-ray optics.** Rodrigues, A.R.D.; Liu, L. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15906 (INIS-BR—748, pp 96) **Pulse conformator.** Souza, R.E. de; Nascimento, G.C. do. (Pernambuco Univ., Recife, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15907 (INIS-BR—748, pp 97) **Display device for image processing.** Garcia Neto, A.; Slaets, J. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

15908 (INIS-BR—910, pp 56) **How to convert VARIAN E-500 Gaussmeter into field stabilizer.** Nadolski, S.; Santos, E.J.P. (Polska Akademia Nauk, Warsaw; Pernambuco Univ., Recife, Brazil. Dept. de Fisica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

15909 (INIS-mf—10778) **Optimization of the time resolution and the sensitivity in the pulsed nuclear resonance.** Umathum, R. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1987. 167p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751509/JAW.

The time resolution of pulsed NMR spectrometer and its spectral sensitivity are closely connected together. An important obstacle in the attempt to increase the resolution represents the dead time of the spectrometer. In the present thesis therefore the different contributions to the system dead time and their causes are analyzed and ways to the reduction respectively complete removement of a part of these contributions are indicated. So a duplexer was developed and constructed on the base of a principle novel for the NMR under application of quadrature hybrids which reduces the residual voltage of the sender pulse to less than 1/10 of the hitherto reached value. In this thesis a concept is extensively discussed which allows to generate at constant quality respectively damping constant of the sample circuit and given sender power a larger high frequency field strength than it is possible in the state of the power fitting. It could be shown than also concerning the noise behaviour by the application of the principle of the defined misfit no compromise must be made but it is even facilitated to approach the ideal of the noise fit of the first receiver stage to the sample circuit. (orig./HSI).

15910 (INIS-mf—11031) **Modular CAMAC system. 2.** Hajek, B. (ed.). (Ceskoslovenska Komise pro Atomovou Energii, Prague). Sep 1986. 99p. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700237/JAW.

Normalizace v jaderne technice.; (no.2).

The application is described of the modular CAMAC system in technical practice and its use in nuclear instrumetation. The set of instruments of the NL 2000 series is designed for measurement and control in laboraories and in industries. The basic data and properties of the NL system are given and a list presented of units developed. The general characteristics are given of the MULTIBUS II system which features flexibility and versatility in a wide range of applications. The full texts are given of CMEA standards 4919-84: CAMAC System - Rack and modules, and 5393-85: CAMAC System - Several controllers in the rack.

15911 (INIS-mf—11093, pp 60-61) **Development of an X-ray crystal spectrometer.** Toeroek, I.; Toth, B. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

15912 (INIS-mf—11093, pp 62-63) **Scientific program package for the processing of XPS spectra.** Cserny, I. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

15913 (IPEN-Pub—110) **Hollow cathode lamp-construction aspects.** Tomiyoshi, I.A.; Mirage, A.; Gorski, M.S.; Lima, W. de. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Jul 1987. 14p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700244/JAW.

The hollow cathode discharge is a source used for absorption and fluorescence atomic spectrophotometry. In this paper various aspect like construction, cleanliness and operation have been described. The life time of the hollow cathode discharge for specific current is about 500 hs. The range of current for the non significant self-absorption of the recommended wavelenght has been determinated.

15914 (ITEF—86(1985)) **Thermoresistor for cryogenic studies.** Ryzhkov, A.A.; Semenov, Yu.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700250/JAW.

A thermoresistor meter for operation in an ultralow temperature range is described. The resistance measurement range is up to 10^6 Ω. The operating frequency is 27 Hz. The measuring current is 200-0.1 nA. The integral nonlinearity is 0.1%. The measurement results can be displayed on a digital voltmeter and a self-recording device. 4 references, 5 figures.

15915 (ITEF—165(1985)) Specific features of readout system of the PSP-2 measuring device. Polikarpov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700252/JAW.

An updated part of the readout channel of the PSP-2 automatic scanning device providing image element coding along the scanning line is described. It is described how the reference system is formed on the basis of automatic frequency control. The described system designs have enabled to work with a measuring grid lacking necessary fabrication precision and significantly reduced the number of equipment while simplifying its adjustment. The device has been successful in operation for a long time providing the necessary image coding parameters from different information sources. 6 references, 8 figures.

15916 (K/D—5738) The evaluation of accelerometer mount transmissibility for US Navy applications. Strunk, W.D. (Oak Ridge National Lab., TN (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1988. Contract AC05-84OT21400;AC05-84OR21400. 10p. (CONF-880220—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004500/JAW.

From 6. international modal analysis conference; Orlando, FL, USA (1 Feb 1988).

Permanently attached measurement point hardware is used in US Navy shipboard applications for both machinery monitoring and modal analysis. Various accelerometer mount configurations seen as having a high potential for long term survival, were vibration tested on a shaker table and compared for transmissibility in the frequency range from 0.2 to 10,000 Hz. Candidates tested included, after initial screening, six adhesives and three mechanical connectors. To simulate the harsh environment of a ship's engine room, the adhesives were exposed to 160°F water and 120°F oil before the testing began. The transmissibility of all mount configurations is compared and ranked with a base case threaded stud mount. 12 figs.

15917 (LA—11148-MS) The use of optical fibers for shock pressure and timing measurements at high pressures. George, M.J.; Menikoff, R.; Veeser, L.R. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-36. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004012/JAW.

We have investigated the use of quartz fibers as arrival-time detectors and as absolute pressure transducers for shock waves at pressures of 50 GPa and higher. Four experiments were fired in which a steel flyer plate impacted an instrumented steel target plate. Arrival times measured with the fibers are compared with those given by more conventional electrical pin switches. Additional signal features are related to hydrodynamic events and compared with calculations. Calibrated signal voltages are related to shock temperatures through blackbody radiation theory. The temperatures are then related to pressures using shock Hugoniot data, and the results compare favorably with those of the hydrodynamic calculations. 2 refs., 21 figs., 1 tab.

15918 (LBL—24301) A 20mK temperature sensor. Wang, N.; Sadoulet, B.; Shutt, T.; Beeman, J.; Haller, E.E.; Lange, A.; Park, I.; Ross, R.; Stanton, C.; Steiner, H. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 6p. (CONF-871006—34). NTIS, PC A02. Order Number DE88004445/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

We are developing a 20mK temperature sensor made of neutron transmutation doped (NTD) germanium for use as a phonon detector in a dark matter search. We find that NTD germanium thermistors around 20mK have resistances which are a strong function of temperature, and have sufficient sensitivity to eventually reach a base line rms energy fluctuation of 6eV at 25mK. Further work is needed to understand the extreme sensitivity of the thermistors to bias power. 13 refs., 18 figs.

15919 (ND-R—1373W) Flow meters for the PAT loop. Rapier, A.C.; Rule, I.C.; Green, R.A. (UKAEA Risley Nuclear Power Development Establishment). Mar 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750844/JAW.

The flow of coolant in the PAT loop at temperatures in the range 200°C to 600°C and a pressure of 40 bar must be measured accurately. It is not possible to provide good upstream flow conditions for a flow meter in the complicated pipework or to calibrate a flow meter in the loop itself. Two independent combined flow conditioner and orifice meter units for subsequent insertion into the loop were designed, built and independently calibrated. The discharge coefficient was determined over the working range of Reynolds number by comparison with a standard orifice plate in the WNL high pressure gas loop. Tests at atmospheric pressure have demonstrated that, to the accuracy of measurement, the discharge coefficients of the units are unaffected by disturbances to the upstream flow.

15920 (PB—88-123781/XAB) NBS (National Bureau of Standards) measurement services: spectral-irradiance calibrations. Special pub. (Final). Walker, J.H.; Saunders, R.D.; Jackson, J.K.; McSparron, D.A. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Sep 1987. 106p. (NBS/SP—250/20). NTIS, PC A06/MF A01.

Also available from Supt. of Docs. as SN003-003-02829-1. See also PB—88-123674, and PB—88-123708; Library of Congress catalog card no. 87-619862.

The report describes the measurement methods and instrumentation used in realization and transfer of the NBS scale of spectral irradiance. The basic measurement equation for the irradiance realization is derived. The spectral responsivity function, linearity of response, and size of source effect of the spectroradiometer are described. The analysis of sources of error and estimates of uncertainty are described. The analysis of sources of error and estimates of uncertainty are described. The assigned uncertainties (3-sigma level) in spectral irradiance range from 2.2% at 250 nm to 1.0% at 654.6 nm to 6.5% at 2400 nm.

15921 (RFP—4116) Electromechanical timing measurement technique. Kortekaas, N.C.; Thomas, R.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 8 Oct 1987. Contract AC04-76DP03533. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005098/JAW.

In industry, the performance of the electromechanical device is gauged by its timing characteristics. Necessary in situ time interval measurements are impossible because counters require triggering events, which are absent during device operation and impractical because the mechanical structure of the device cannot be readily changed to accommodate such measurements. A method is introduced for determining the device timing characteristics by measuring and sampling the response current or voltage under static and dynamic conditions during the effective periods the device is operated. A theoretical model is presented to explain electromechanical behavior and the timing characteristics; it also provides a format for a software routine, which computes the timing characteristics from the measurement data.

15922 (RFP—4132) Calibration of a Harwood DWT-1000 controlled-clearance piston gauge. Shain, D.I.; Deitesfeld, C.A. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 30 Sep 1987. Contract AC04-76DP03533. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004496/JAW.

To meet growing demands for higher pressure measurements and measurement accuracies up to 200,000 psig, the Physical Metrology Laboratory (PML) at Rocky Flats Plant, Golden, Colorado, purchased and calibrated a Harwood Model DWT-1000, controlled-clearance piston gauge. Calibration of the DWT-1000 followed guidelines established by the National Bureau of Standards (NBS). The pressure medium used during operation and calibration of the system was n-Heptane. Due to the flammability of n-Heptane, safety enclosure was designed and constructed around the

DWT-1000 which, when used in conjunction with a data acquisition console, monitors both safety and calibration equipment while protecting the surrounding environment in the event of a sudden pressure release. Calibration results and procedures are compiled in this report to assist those who will be or are presently confronted with the challenge of calibrating a similar type controlled-clearance piston gauge. 4 refs., 3 figs.

15923 **(SAND—87-2697C) Modern pulsed wavemeters.** Reiser, C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 20p. (CONF-880110—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003875/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

Several technologies are available for interferometrically measuring laser wavelength to the precision of a Doppler width. These include instruments based on Fabry-Perot etalons, Fizeau wedges, Michelson interferometers, and other novel schemes. The current state of the art of these instruments is reviewed. Two new pulsed wavemeter designs are presented, the solid Fizeau wedge and the index mismatched interferometer. These instruments exhibit accuracies in the 10^6 range, and are very compact and inexpensive to fabricate. 28 refs., 10 figs.

15924 **(SAND—87-3033C) Calibration of beam power monitors for laser welding.** Thacher, P.D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880110—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004687/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

Calibration of a Coherent Radiation Model 213 laser power sensor is reviewed. The calibration chain is traced from the National Bureau of Standards (NBS) through transfer calibrations to a working sensor. Uncertainty components in this chain, including those for use conditions, are combined to give a root-sum-square uncertainty of 7% for use of this device. 7 refs., 5 figs., 7 tabs.

15925 **(TRI-PP—87-77) Three-dimensional image reconstruction in object space.** Kinahan, P.E.; Rogers, J.G.; Harrop, R.; Johnson, R.R. (TRIUMF, Vancouver, British Columbia (Canada)). 1987. 4p. (CONF-871006—37). NTIS (US Sales Only), PC A02. Order Number DE88900279/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

An analytic three-dimensional image reconstruction algorithm which can utilize the cross-plane gamma rays detected by a wide solid-angle PET system is presented. Unlike current analytic algorithms it does not use Fourier transform methods, although mathematical equivalence to Fourier transform methods is proven. Results of implementing the algorithm are briefly discussed. An extension of the algorithm to utilize all measured cross-plane gamma rays is discussed.

15926 **(UCID—21170) Photon drag detector for mm-wave radiation in MTX [Microwave Tokamak Experiment].** Verboncoeur, J.P. (California Univ., Berkeley (USA). Dept. of Nuclear Engineering; Lawrence Livermore National Lab., CA (USA)). 8 Dec 1987. Contract W-7405-ENG-48. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004487/JAW.

Photon drag detectors for high-power fast-pulsed microwave detection in the far infrared to mm-wavelengths are discussed in detail. Suitability of photon drag detection for use as a microwave diagnostic in the Microwave Tokamak Experiment (140/250 GHz ECRH heating using 50 ns FEL pulses of $\approx$ 8 GW peak, 2 MW average power at a 5 kHz repetition rate) is discussed, including effects of radiation, RF noise, and strong ($\approx$ 9 teals) crossed magnetic fields. Based on the theory, prototype photon drag detectors are designed and tested using a 200 W Extended Interaction Oscillator (EIO) at 140 GHz. Response time and NEP of the prototype detectors cannot be tested with this source due to the slow rise time of the EIO (500 ns) and the noisy RF environment in its vicinity. Empirical sensitivities of the detectors are determined to be 5 μV/W and 2.5 μV/W respectively, for a 30 Ω-cm (impurity concentration $\approx 1.7 \cdot 10^{14}$ cm^{-3}) n-type detector and a 36 Ω-cm (impurity concentration $\approx 4.5 \cdot 10^{14}$ cm^{-3}) p-type detector. Theory predicts sensitivity of four times the empirical value; the disparity is attributed to engineering factors in the power coupling. 27 refs.

15927 **(UCRL—96412) Performance of a photon counting microchannel plate intensifier with wedge and strip image readout.** Siegmund, O.H.W.; Hailey, C.J.; Lupton, J.H.; Stewart, R.E. (Lawrence Livermore National Lab., CA (USA); California Univ., Berkeley (USA). Space Sciences Lab.; KMS Fusion, Inc., Ann Arbor, MI (USA)). 26 Aug 1987. Contract W-7405-ENG-48. 18p. (CONF-8709139—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003831/JAW.

From 9. symposium on photoelectronic imaging devices; London, UK (7 Sep 1987).

We have developed a 40mm aperture sealed tube imaging detector for photon counting applications in astronomy and atomic physics. The device has a fiber optic input window with a semitransparent bialkali photocathode deposited on its inner surface. The photocathode is proximity focussed to a stack of three microchannel plates (MCP's), each having an 80:1 channel length to diameter ratio, placed in a back to back (Z) configuration. The signal levels on the wedge and strip electrodes of the readout anode, behind the MCP stack, are linearly proportional to single photon event X and Y positions. The event positions are deduced by direct digitization of the individual wedge, strip and zig-zag amplified signals, followed by calculation of the X and Y positions in software. 5 refs., 8 figs.

15928 **Monotonic responses from monochromatic optical particle counters.** Barnard, J.C.; Harrison, L.C. (Pacific Northwest Laboratory, P.O. Box 999, Richland, Washington, 99352). *Applied Optics;* **27**: No. 3, 584-592(1 Feb 1988). Contract AC06-76RL01830.

Mie theory is used to investigate the degree to which a response from an optical particle counter (OPC) can be made monotonic when sizing particles of a given refractive index. This investigation is restricted to OPC designs that use monochromatic illumination and have coaxial light-collection optics. By systematically exploring the angular limits of the collection optics, it is found that, for certain limits, a very nearly monotonic response can be achieved for a nonresonant cavity OPC for a range of refractive indices. In contrast, for a resonant cavity instrument, this investigation did not reveal any angular limits where the response is close to being monotonic, unless the refractive index of the particles being sized has a large imaginary component.

15929 **Measurement of mixing fluid flows with optical tomography.** Snyder, R.; Hesselink, L. (Department of Aeronautics/Astronautics and Electrical Engineering, Stanford University, Stanford, California 94305-2186). *Optics Letters;* **13**: No. 2, 87-89(Feb 1988).

We present what is, to our knowledge, the first instantaneous optical tomographic reconstruction of a nonstationary fluid flow. Holographic interferometry is used to measure optical path length through a coflowing helium jet in air along several views. The spatial distribution of the helium concentration is determined from these measurements. Eighteen views through a 7-cm-diameter, 7-cm-high cylindrical volume are recorded, yielding a spatial resolution of 3 mm with an error of less that 3%. When a 1-W argon-ion laser is used, the temporal resolution is 300 @gmsec.

15930 **Velocimetry of fast surfaces using Fabry—Perot interferometry.** McMillan, C.F.; Goosman, D.R.; Parker, N.L.; Steinmetz, L.L.; Chau, H.H.; Huen, T.; Whipkey, R.K.; Perry, S.J. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Review of Scientific Instruments;* **59**: No. 1, 1-21(Jan 1988).

This article describes the use of the Fabry—Perot laser interferometer in the fringe mode to measure velocities of fast-moving reflecting surfaces, and includes a review of previously published

work. We begin by describing the theory of the Doppler shift that applies to these situations, and include an experimental test of whether surface normal direction affects Doppler shift. Formulas are derived for the analysis of the effects of shocked, dispersive, moving transparent media on velocity measurements, including expressions for the velocity of light in a moving medium with moving boundaries. The Fabry—Perot method is compared with other techniques such as the VISAR interferometer. We then describe in detail a standard configuration developed at our facilities, discuss other configurations using optical fibers and more than one cylinder lens, and describe a new laser amplifier developed specifically for velocimetry. Methods of alignment, instrument calibration, surface preparation, and operation are included. Next, we present several methods of analysis, the choice of which depends on the absolute accuracy required, and examine many sources of possible error. These analytical techniques allow the motion of surfaces of reflectivity of at least 1% to be measured with an absolute precision of 0.5%. Time resolution can be a few nanoseconds, and is traded off for velocity resolution. One can make continuous velocity records of surfaces whose reflectivity under shock loading decreases to less than 1% of its initial value. We have simultaneously recorded three distinct velocity—time histories without ambiguity.

15931 **Angular scanning stage for glancing-incidence surface EXAFS.** Jiang, D.T.; Alberding, N.; Seary, A.J.; Crozier, E.D. (Physics Department, Simon Fraser University, Burnaby, British Columbia V5A 1S6, Canada). *Review of Scientific Instruments;* **59**: No. 1, 60-63(Jan 1988).

In this paper a simple and inexpensive angular positioning apparatus is described which can be applied to measurements of x-ray reflectivity and extended x-ray absorption fine structure (EXAFS) at glancing angles of incidence. An efficient interactive alignment procedure is discussed and the performance of the device is given.

15932 **Low background-rate detector for 40-keV ions using a conversion dynode and a microchannel-plate electron multiplier to reject low-energy ions, electrons, and photons.** Friedman, P.G.; Bertsche, K.J.; Michel, M.C.; Morris, D.E.; Muller, R.A.; Tans, P.P. (Lawrence Berkeley Laboratory, University of California, California 94720). *Review of Scientific Instruments;* **59**: No. 1, 98-111(Jan 1988). Contract AC03-76SF00098.

We have developed and tested an inexpensive ion detector with dark-count rates below 10^{-4} s^{-1} and excellent background rejection. Each 40-keV ion that strikes a grazing-incidence Al_2O_3 conversion dynode ejects a few tens of secondary electrons, which enter separate pores of a microchannel plate and are independently multiplied to saturated pulse height. The pulses are summed to produce an output signal that is proportional to the number of secondary electrons. This permits pulse-height discrimination against backgrounds of low-energy ions, electrons, and photons. We have successfully tested the detector with C^+, Na^+, K^+, Rb^+, and Cs^+ at 5—40 keV, and with 36-keV C^- and CH^-. It should detect ions and neutrals of all species, at energies above 5—10 keV, with good efficiency and excellent background discrimination. Counting efficiency and background discrimination improve with higher ion energy. The detector can be operated at pressures up to at least 2×10^{-7} Torr and be exposed to air repeatedly without requiring reactivation. The maximum ion count rate is 3×10^6 s^{-1} in pulse-counting mode and 6×10^9 s^{-1} in current-integrating mode. Detection of 40-keV ions at rates below 10^{-2} s^{-1} was required in development of a 10-cm radius 40-keV cyclotron dedicated to high-sensitivity radioisotope dating by accelerator mass spectrometry (AMS). In the cyclotron, the detector suppresses to 6×10^{-4} s^{-1} the background count rate from the presence of low-energy ions, photons, and electrons.

15933 **Variable bandpass filter with high rejection ratio for Raman scattering.** Huang, Y.; Yu, P.Y. (Department of Physics, University of California and Materials and Chemical Science Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Review of Scientific Instruments;* **59**: No. 1, 190-191(Jan 1988). Contract AC03-76SF00098.

A variable bandpass filter with a stray light rejection ratio as good as 10^{-8} is described. The applications of this filter in removing elastically scattered laser light from poor quality sample surfaces in Raman scattering are discussed.

15934 **Energy-modulated x-ray microtomography.** Kinney, J.H.; Johnson, Q.C.; Saroyan, R.A.; Nichols, M.C.; Bonse, U.; Nusshardt, R.; Pahl, R. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Review of Scientific Instruments;* **59**: No. 1, 196-197(Jan 1988). Contract W-7405-ENG-48.

We describe an instrument for computerized x-ray tomography which can provide fully three-dimensional examination of small samples (a few millimeters to a few centimeters) with resolution variable from 5 to 100 μm. Elemental and chemical-state distributions are obtained with high resolution by modulating the energy of the incident x-ray beam. An essential component is the monochromator we designed and optimized for chemical microtomography. It has a narrow energy bandpass and a large degree of harmonic suppression, provides a uniform x-ray beam with small angle of divergence, and is cooled in a way that eliminates thermal and vibrational instabilities.

15935 **High-resolution Fresnel zone plates for soft x rays.** Vladimirsky, Y.; Kern, D.; Chang, T.H.P.; Attwood, D.; Ade, H.; Kirz, J.; McNulty, I.; Rarback, H.; Shu, D. (IBM T. J. Watson Research Center, Yorktown Heights, New York 10598). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **6**: No. 1, 311-315(Jan 1988).

Fresnel zone plates with minimum zone widths down to 50 nm were fabricated by electron-beam lithography, tested, and used in the scanning x-ray microscope at the Brookhaven National Synchrotron Light Source. The zone plates consist of gold rings on a silicon nitride window. Characterization of the zone plates included efficiency and resolution measurements in the first order focus. Spatial resolution down to 75 nm was measured. The best zone plates showed negligible astigmatism, and a first order efficiency in excess of 5% has been achieved. A new method for development monitoring during the fabrication procedure using an optical microscope with polarized light and crossed analyzer was introduced. For the inspection of the fabrication accuracy and, in particular, for ellipticity, a moire pattern technique was employed. Using these zone plates as objective lenses, x-ray images of biological specimens were obtained with 70 nm resolution.

15936 **Scanning ellipsometer by rotating polarizer and analyzer.** Chen, L.Y.; Lynch, D.W. (Iowa State University, Physics Department, Iowa 50011). *Applied Optics;* **26**: No. 24, 5221-5228(15 Dec 1987).

A new type of scanning photometric ellipsometer with polarizer and analyzer both rotating synchronously at rotation rates of $\omega_0/2$ and ω_0 ($f_0 = 51$ Hz), has been designed and constructed. The mechanical and electrical design, alignment, calibration, and error reduction of the system are discussed in detail. Through measuring the amplitudes of the three ac components from the photomultiplier, at frequencies of 51, 102, an 153 Hz, respectively, complex dielectric function spectra have been obtained for test samples of Au and CdTe in the 1.5—5.5-eV range and shown to be in agreement with the results of others.

15937 **Resonance ionization mass spectrometry for high-resolution spectroscopy of rare isotopes.** Miller, C.M.; Keller, R.A.; Engleman, R. Jr. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 359-360(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Laser-induced resonance ionization has resulted in single atom detection of a few elements and very sensitive detection of many others. It has been found to be particularly fruitful to combine resonance ionization with mass analysis of the resultant ions to form a technique labeled resonance ionization mass spectrometry (RIMS). In a typical RIMS experiment, a broadband tunable dye laser is used to ionize a particular element in the source chamber of a mass spectrometer (element selective ionization). Isotope ratio measurements are then made by mass dispersion of the ions in the

mass spectrometer. Since the ionization is element selective, the isobaric interferences that often plague mass spectrometric analysis can be essentially eliminated. A single-frequency, tunable laser can also be used to effect photoionization, and high-resolution spectra can be acquired by sweeping the tunable laser through the atomic resonance of interest. Here again, the combination of photoionization with mass analysis of the ions is very advantageous. By tuning the mass spectrometer to transmit only the isotope of interest, high-resolution spectra of rare isotopes can be obtained without complete chemical or isotopic separation of the samples. To demonstrate the utility of this technique, we show that spectra of rare lutetium isotopes, present in our sample at concentrations of ~ 30 ppm, can be obtained with good signal-to-noise. Analysis of the hyperfine patterns of these spectra leads to values of nuclear parameters, some previously unknown.

15938 **Exploiting the optical isotope shift for ultrasensitive isotopic analysis with lasers.** Lucatorto, T.B.; Hutchinson, J.M.R.; Whitaker, T.J. *Transactions of the American Nuclear Society;* 52: 360-361(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The authors are currently engaged in a program to determine the potential of resonance ionization mass spectrometry (RIMS) for ultrasensitive isotopic measurements and for the determination of certain nuclear properties (e.g., spin and magnetic moment) of rare isotopes. The RIMS process has been under development for the past 5 yr or so as a technique for ultrasensitive elemental analysis. In RIMS, conventional mass spectrometry is combined with resonant laser ionization to provide sensitive, selective detection of elemental species. The resonance ionization process can achieve (by virtue of enormous resonance enhancement) nearly unit efficiency ionization of a selected elemental species. The mass spectrometer provides mass-specific (more precisely, mass-to-charge ratio specific) detection of the ion with near unit efficiency. Recently, RIMS was used to detect 1000 ^{81}Kr atoms in a background of 10^7 ^{80}Kr and ^{82}Kr atoms and 10^{12} atoms of other elements. It has also provided part-per-billion sensitivity in the measurement of gallium in solid silicon.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 13980, 15272, 15666

15939 **(LA—6949-MS-Rev.2) EXPLO: Explosives thermal analysis computer code.** Jaeger, D.L.; Vigil, A.S. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001938/JAW.

The finite difference method is used to calculate temperature fields and times to initiation for explosive materials. The code is one-dimensional and is programmed for Cartesian, cylindrical, and spherical coordinates. Temperature-dependent properties, phase changes, and multiple heat source terms are allowed. Multiple source terms use Nth-order Arrhenius kinetics for each material component. Temperature, flux, convection, or radiation boundary conditions may be employed. Internal convection is considered for materials that undergo a solid/liquid phase change. The Crank-Nicholson implicit solution method, which allows large time steps and short running time, is used. 7 refs., 29 figs.

15940 **(LA—11158-M) NF85: A three-dimensional, air-dynamics computer code for analyzing explosions in structures.** Steinke, R.G. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 137p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88005085/JAW.

The NF85 (Near-Field 85) computer program analyzes the effect of explosions on the dynamic behavior of air in structures. The explosion is modeled as a time- and spallese-dependent source of equivalent air mass and energy. Chemical reactions can be modeled directly with a combustion-model option, and tracer particles may be used to monitor combustion-products convection by the air. The near-field region of the explosion is modeled in three-dimensional cartesian or cylindrical geometry. Internal structures can be defined in the region to reflect shock waves and obstruct airflow. A convenient dump/restart capability allows the movement or removal of internal structures during the transient solution. The effects of the surrounding far-field region are modeled at the three-dimensional region's external boundary by a wall surface, time- and space-dependent pressure or velocity boundary conditions, and/or one-dimensional cartesian-geometry regions attached to openings in the external boundary. Ventilation ducts, passageways, and adjacent rooms can be modeled directly with one-dimensional regions, and the presence of blowers and filters can be modeled as well. One-dimensional regions in NF85 cannot be interconnected, thus requiring the approximation of complex flow-network geometry in the far field. An approximate far-field representation only needs to model its feedback effect on the near-field region accurately to obtain an accurate near-field solution. From it solution, NF85 can optionally edit the time-dependent solution-state condition at any location in its region of solution. This then may be used as an accurate boundary condition for the EVENT84 one-dimensional flow-network computer program to enable it to efficiently evaluate the air-dynamics behavior in a complex flow-network geometry of the far field.

15941 **(LA-UR—87-4077) A lecture on detonation-shock dynamics.** Stewart, D.S.; Bdzil, J.B. (Illinois Univ., Urbana (USA); Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 20p. (CONF-8708205—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004313/JAW.

From US/Japan workshop on combustion; Juneau, AK, USA (1 Aug 1987).

We summarize recent investigations into the theory of multi-dimensional, time-dependent detonation. These advances have led to the development of a theory for describing the propagation of high-order detonation in condensed-phase explosives. The central approximation in the theory is that the detonation shock is weakly curved. Specifically, we assume that the radius of curvature of the detonation shock is large compared to a relevant reaction-zone thickness. Our main findings are: (1) the flow is quasi-steady and nearly one dimensional along the normal to the detonation shock; and (2) the small deviation of the normal detonation velocity from the Chapman-Jouguet (CJ) value is generally a function of curvature. The exact functional form of the correction depends on the equation of state (EOS) and the form of the energy-release law. 8 refs.

15942 **(UCID—20870) The Multistage Conventional Munitions Development Program.** Bell, R.B.; Chase, J.B.; Repp, G.W.; Abey, A.E.; Moor, E.H.; Morrison, J.J.; Thorpe, R.K. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87000903/JAW.

This report documents work done from late 1983 to early 1986 Lawrence Livermore National Laboratory (LLNL) on the Department of the Army (DA) and Defense Advanced Research Project Agency (DARPA) funded Multistage Conventional Munitions (MCMs) Development Program. Despite early termination of the program, many technical accomplishments resulted that we wish to document, especially in the event of future renewed interest in the MCM technology or demolitions. The document consists of an executive summary of the technical data and conclusions that resulted from our work as well as a set of appendices describing accomplishments in each technical area in detail such as: targets, lethality, forward shaped charge, forward shaped charge, follow through charge, propulsion, fuzing, high explosives, and system engineering.

15943 **(UCRL—53827) Compression of two extrusion-cast explosives to 500 MPa.** Costantino, M.; Tao, W.; Ornellas, D.; Clements, R. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003271/JAW.

Experimental data is presented for room-temperature isothermal compression of two extrusion-cast explosives, RX-08-FO and

RX-08-EL. The samples, were loaded hydrostatically to 500 MPa at strain rates between 1 x 10^{-4} s^{-1} and 2 x 10^{-4} s^{-1}. Volume compression was found by measuring the change in length of a bellows piezometer and relating it to a change in volume with a calibration based on the equation of state of water. We defined the P-V curve for each material by averaging the results from several runs, using a nonlinear regression analysis to fit the data for each run to a first-order Murnaghan-form equation. Maximum volume compressions for both materials were near 5%, and their bulk moduli were found to be near 6 GPa at ambient pressure and to increase by a factor of two as the pressure rose to the 500-MPa maximum reached in the tests. These are the first static-high-pressure compressibility data obtained for extrusion-cast explosives. By correlating these data with data from other investigators' experiments, such as uniaxial compression tests on similar materials, we can observe the strong stress dependence, temperature dependence, and time dependence of the bulk properties of these materials. 12 refs., 5 figs., 2 tabs.

15944 **Study of detonation processes in heterogeneous high explosives.** Tang, P.K. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* 63: No. 4, 1041-1045(15 Feb 1988). Contract W-7405-ENG-36.

A model of multiple processes is used to simulate the behavior of reaction in detonation of heterogeneous high explosives. The features of the model are (1) the partition of the explosive medium into hot spots and the region exclusive of hot spots and (2) the separation of the mechanical-thermal process and chemical process. For each process, a characteristic time is assigned and is defined by a phenomenological relation. With assumptions, some fast processes are ignored in the governing equations. This investigation indicates the necessity of including a slow process near the end of the reaction. Comparisons with experiments using a Fabry—Perot velocimeter are presented for triaminotrinitrobenzene.

15945 **Infrared multiphoton dissociation of RDX in a molecular beam.** Zhao, X.; Hintsa, E.J.; Lee, Y.T. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* 88: No. 2, 801-810(15 Jan 1988).

Infrared multiphoton dissociation (IRMPD) of hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in a molecular beam has been performed in order to investigate the mechanism of RDX thermal decomposition. A beam of molecules was crossed by a pulsed TEA CO_2 laser and velocity distributions of the various products were measured by the time-of-flight (TOF) technique as a function of the laboratory angle using a mass spectrometric detector. The dissociation channels, their branching ratios, and the translational energy distributions of the products were determined. In contrast to the conventional view of simple bond rupture through loss of NO_2 as the dominant primary channel in RDX decomposition, it was found that the dominant primary channel is concerted symmetric triple fission to produce three $CH_2N_2O_2$ fragments which subsequently undergo secondary concerted dissociation to produce HCN, H_2CO, HONO (or HNO_2), and N_2O. A total of two primary and four secondary dissociation channels were observed. Concerted reactions predominate over simple bond rupture not only in the number of channels (four vs two) but also in the amount of products. A fair amount of translational energy release through concerted reaction channels was observed, which is significant for an explanation of the energies of RDX decomposition.

4502 Nuclear

REFER ALSO TO CITATION(S) 14490, 16280

15946 **(AD-A—185685/5/XAB) Ferromagnetic mitigation of electromagnetic-pulse effects. Memorandum report.** Maisch, W.G.; Vittoria, C.; Folen, V.J. (Naval Research Lab., Washington, DC (USA)). 8 Oct 1987. 24p. (NRL-MR—6099). NTIS, PC A03/MF A01.

A realistic description of EMP shielding by ferromagnetic materials was developed in this paper. The attenuation of three pulses by a typical ferromagnetic shield is described. Moreover, the form of this description readily allows for the inclusion of specific properties of ferromagnetic materials (e.g. magnetic relaxations, domain structure and magnetostriction) in calculations of shielding effectiveness.

15947 **(UCID—20961) Nuclear weapon R and D and the role of nuclear testing.** Brown, P.S. (Lawrence Livermore National Lab., CA (USA)). Jan 1987. Contract W-7405-ENG-48. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87005202/JAW.

As one of the nation's weapons design laboratories, LLNL plays a vital role in designing and maintaining the nuclear weapons that make up the US nuclear deterrent. To fulfill this responsibility, the Weapons Program at LLNL has sustained four broad-based efforts: (1) ensuring that the weapons in the stockpile are safe and reliable; (2) developing warhead options for new weapon systems; (3) maintaining expertise in nuclear weapons design and development; and (4) providing technical support for this nation's objectives in arms control and verification. John D. Immele, Deputy Associate Director for Nuclear Design, James V. Tyler, Assistant Deputy Associate Director for Military Applications, and Paul S. Brown, Assistant Associate Director for Arms Control, discuss the Weapons Program at LLNL and the philosophy and process of developing nuclear weapons for the nation's strategic deterrent.

15948 **(UCID—21286) Maneuverable reentry vehicle trajectory footprints: Calculation and properties.** Handler, F.A. (Lawrence Livermore National Lab., CA (USA)). 20 Nov 1987. Contract W-7405-ENG-48. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004726/JAW.

We have obtained an analytical solution of MAneuverable Reentry Vehicle (MARV) trajectory equations that provides useful estimates of a MARV's potential impact footprint on the ground. We concentrate on quick footprint estimation, as required for battle management of a terminal strategic defense system, but we also present other applications such as evaluating tradeoffs between MARV trajectories, design capabilities, and resulting footprints. We estimate the footprint by analytically solving three types of maximal maneuvering trajectories in which the MARV combines maximal turns, lifts or dives through specified angles, finally attempting to extend level flight as long as possible. We display several quantitative results, for a range of MARV capabilities, including variation of footprint area with trajectory incidence angle, altitude, and lift capability. We find that footprint area decreases rapidly as altitude decreases due to the exponentially increasing atmospheric drag. Further, the eccentricity of the footprints depends sensitively on the altitude, incidence angle and velocity, ranging from 0.1 to 0.8. Footprint area increases as lift capability of the MARV increases, roughly as the 3/2 power of lift for a trajectory with incidence angle of 20 degrees. 2 refs., 14 figs.

15949 **(UCRL—52000-86-9) Energy and technology review: Weapons design and development.** (Lawrence Livermore National Lab., CA (USA)). Sep 1986. Contract W-7405-ENG-48. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87003087/JAW.

The weapons design and development program at Lawrence Livermore National Laboratory is summarized in four brief papers. These contributions discuss the weapons program at LLNL, nuclear weapon research and development and the role of nuclear testing, nuclear weapon development, and the weaponization program.

15950 **(UCRL—97519) Estimation of the bulk diffusivity of chimneys using post-shot holes.** Burkhard, N.; Hearst, J.R.; Hanson, J.M. (Lawrence Livermore National Lab., CA (USA); Hanson and Associates, Salt Lake City, UT (USA)). 1987. Contract W-7405-ENG-48. 29p. (CONF-8709215—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003294/JAW.

From 4. symposium of underground nuclear explosions; Colorado Springs, CA, USA (21 Sep 1987).

LLNL has been calculating the bulk diffusivity of chimney regions using measurements of atmospheric pressure variations. Fluctuations in atmospheric surface pressure and subsurface pressure (measured in a post-shot hole of opportunity) are compared to

determine the diffusivity. The diffusivities calculated to date range from about 130 to 31,000 m^3/hr. Time and frequency domain techniques have been utilized to determine this range of diffusivity. Some limitations of this method of diffusivity determination have been discovered. Useful data have been obtained in the frequency band 0.002-0.03 cycles/hour. The effect of the water table upon our measurements has been determined. The theoretical impulse response functions for a typical geologic setting can be quite long (>300 hours). Therefore, the surface pressure history for time spans greater than this or the entire initial pressure distribution ($p(z,t = 0)$) in the geologic setting must be known before gas transport predictions from transport models can be reliably made, as the driving pressures for transport depend upon these initial conditions. 7 refs., 17 figs., 2 tabs.

15951 **(UCRL—97877) Maintaining the US stockpile of nuclear weapons during a test ban.** Kidder, R. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 27p. (CONF-880144—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005037/JAW.

From International scientific symposium on a nuclear test ban; Las Vegas, NV, USA (15 Jan 1988).

We review here results of several classes of US nuclear weapons tests conducted within the past decade, together with the principal strengths and weaknesses of nuclear weapons themselves. It is found that a high degree of confidence in the reliability of the existing stockpile is justified, and that it is sufficiently robust to permit confidence in the reliability of remanufactured warheads in the absence of nuclear explosive proof-tests. We also review problems encountered with the 14 nuclear weapon designs since 1958 that have been frequently and prominently cited as evidence that a Low-Threshold Test Ban (LTTB) or a Comprehensive Test Ban (CTB) would preclude the possibility of maintaining a reliable stockpile. It is concluded that the experience has little if any relevance to the question of maintaining the reliability of the stockpile of nuclear weapons that exists in 1987. It is recommended that the Department of Energy be encouraged to undertake the formulation and execution of a Readiness Program whose purpose is to ensure that the US is prepared to maintain the reliability of its stockpile of nuclear weapons in the absence of nuclear explosive tests, and that funds earmarked for this purpose be provided.

15952 **Sterling revisited: The seismic source for a cavity-decoupled explosion.** Glenn, L.A.; Denny, M.D.; Rial, J.A. (University of California, Lawrence Livermore National Laboratory, Earth Sciences Department). *Geophysical Research Letters;* **14**: No. 11, 1103-1106(Nov 1987).

In the STERLING event, a 0.38 kt nuclear device was exploded inside a roughly spherical cavity, of approximately 17 m radius. The cavity, located in the Tatum salt domain (near Hattiesburg, Mississippi), had been created by a 5.3 kt tamped explosion more than 2 years earlier (Almon event). Analysis of data obtained in SALMON and STERLING indicated a corner frequency for STERLING near 10 Hz, a factor of 4 less than predicted by the simplest decoupling theory. We have performed a comprehensive re-examination of the experimental records and find that the original report was incorrect, a consequence of not properly accounting for noise in the seismic analysis. The new study, based on direct spectral analysis of the free-field data, indicates that the STERLING experiment was in near perfect agreement with theory. This is a potentially significant result for seismic monitoring of a low-yield threshold test ban.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 14397, 15993, 15994, 15997, 15998

15953 **(AD-A—185608/7/XAB) Review of atmospheric ozone and current thinking on the Antarctic ozone hole. Master's thesis.** Fix, R.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). 1987. 98p. (AFIT/CI/NR—87-46T). NTIS, PC A05/MF A01.

A general review of the formation, global distribution and concentration variations on different temporal scales of atmospheric ozone is presented. The nature and extent of the recently discovered Antarctic ozone hole is discussed, and summaries of the various theories that have been advanced to account for this phenomenon are reviewed.

15954 **(GKSS—87/E/29) Experimental and theoretical studies on mass transfer in an artificial rain.** Miss, R.W.; Neumann, H.; Petersen, P.; Deeg, H.J.; Schultheiss, G.F. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). 1987. 64p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751692/JAW.

The decrease of trace gas concentration in a rain is an unsteady process. For this reason the diffusive washout coefficient, which had not as yet been measured properly, could be determined exactly by laboratory experiments only. The setup for the generation of an artificial rain comprised a long upright standing glass vessel, a sprinkling tank fitted with cannulas, a sump with a supply of protective gas, a sulfur dioxide recording instrument and an injection nozzle for the trace gas. - The evaluation of the experiments, which were carried out, showed that for a given drop diameter the mass transfer coefficient of the artificial rain has a constant value, which is independent of rain intensity. There is good harmony between the measured values, the empirical mass transfer relationships and a theoretical flow model. With 20 figs..

15955 **(NILU-OR—2/87) Numerical model suitable for the simulation of a broad class of circulation systems on the atmospheric mesoscale.** Iversen, T.; Nordeng, T.E. (Norsk Inst. for Luftforskning, Lillestroem). Jun 1987. 65p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751210/JAW.

The report constitutes a documentation of a numerical model for the atmospherical mesoscale. The model includes a high resolution planetary boundary layer parameterization, an equation for ground surface temperature and a full scheme for humidity. Long wave radiation is also included. The model is designed to be nested into models on larger scales. A few examples of application are included. 50 refs., 15 figs., 3 tabs.

15956 **(NP—8751663) Work from the departments of the Meteorological Institute of the University of Munich.** Beier, N. (ed.). (Muenchen Univ. (Germany, F.R.). Meteorologisches Inst.). Mar 1987. 229p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

The 37 contributions include a large number of subjects from the wide spectrum of work of micro-meteorology, theoretical meteorology and radiation and satellite meteorology. In the appendix, there is a list of the scientific communications of the Meteorological Institute of the University of Munich in time sequence from 1953 to 1987.

15957 **(NP—8751663, pp 18-23) Role of up-currents in heating valleys.** Brehm, M. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

In order to model the energy transport processes in the up-current layer and in the valley atmosphere, a relationship is proposed between the mean temperature deviation in the up-current layer, the height of the up-current layer and the mean speed. The box model of heating of valleys also takes the heating of the valley floor and the convection mixing processes into account. Investigations have shown that there may be a growth or a reduction in the up-current flow along the hill-side.

15958 (NP—8751663, pp 30-36) **Results of the MERKUR experiment: Structural changes of a weak cold front in the area of the Alps.** Freytag, C. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The examination of fronts and the effect on them of mountains are the research aims of ALPEX. A whole series of works are available on about 15 'front events' during ALPEX-SOP (special observing period March-April 1982). The first results on a weak cold front are shown, which reached the southern spur of the Alps on the 2nd and 3rd of April 1982, but which did not cross the mountains. The passage of the front came in the 3rd intensive measurement phase of the MERKUR experiment. Apart from the ALPEX soundings, the additional measurements during MERKUR are also available. This permits structural investigations with relatively good resolution in the border area mountains/foothills and in the mountains themselves.

15959 (NP—8751663, pp 50-54) **Turbulence structure for high winds.** Loesslein, H. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

Measurements of the size of the eddies in high winds and storms are required to construct a wind load concept. Wind speeds in storms during the period 1979-1981 at Meppen in Emsland are used as the basis for statistically safe information on eddy sizes.

15960 (NP—8751663, pp 55-61) **Extrapolation of extreme values of wind speeds.** Schroers, H. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

In order to prevent damage, the probability of the occurrence of high wind speeds is taken into account in building statistics for a period of 50 years and at a reference height of 10 m above the ground. These statistical data which are at the heart of building technology can only be obtained from complete series of measurements of wind speeds over many years. Three different methods of extrapolation of extreme values are examined from an 18 years' sequence of wind measurements at Garching and some long wind sequences from the German Meteorological Service and the results are introduced.

15961 (NP—8751663, pp 62-67) **Determining the thermal conductivity coefficients of the ground from the progress of the daily temperature curve.** Traup, S. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The hourly averages of the ground temperatures recorded at five depths are recorded in the meteorological station at Garching. A calculation is made of the daily average values of the thermal conductivity coefficient for the period of observation of May to July 1983 from the daily amplitude condition of the ground temperatures at two depths, from the harmonic analysis of the daily temperatures of the i-th partial wave at two depths and from the phase displacement of the i-th partial wave at two depths. The first process gives satisfactory results.

15962 (NP—8751663, pp 68-72) **Vertical sounding of the air layer near the ice on the Vernagtferner (LUZIVER 1983).** Weber, M. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

Using captive sensors pilot balloon ascents and measurements on masts, the vertical profiles of wind, temperature and humidity were examined on a station situated on the glacier outcrop at 2979 m above OD up to about 300 m above the ground for a period of 48 hours. The experiment showed that the development of the glacier wind regime limited to the lowest decametre is mainly controlled by the synoptic position and the orography.

15963 (NP—8751663, pp 74-76) **On the entropy of the Lorenz model.** Egger, J. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The term entropy for a dynamic system is discussed for the example of the Lorenz model. The entropy development in the course of time is determined for some cases.

15964 (NP—8751663, pp 77-79) **Simulation of typical flow in a wide valley.** Graf, J. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The Latrobe valley in Australia has an East-West orientation. It is of interest on the grounds of air hygiene, as there are some large coal-fired power stations in the centre of the valley. Model calculations were done with a three-dimensional mesoscale model, which takes topographical effects into account. The model supplies a typical East wind near the ground in the given synoptic conditions.

15965 (NP—8751663, pp 80-83) **Model calculations on the behaviour of cold fronts influenced by orography.** Haderlein, K. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The model predicts the behaviour of a single barotropic layer using the physics of flat water equations in the f-level. The model calculations were done with one- and two-dimensional mounting profiles. Data on the distribution of the population and precipitation are not possible with the version of the model introduced because of lack of vertical resolution.

15966 (NP—8751663, pp 84-88) **Dense flow at the edges of mountains.** Hartjenstein, G. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

Cold fronts are deformed when they approach a mountain range. If a front moves parallel to the edge of the mountains, it accelerates before the mountains. A very quick-moving squall line sometimes occurs in connection with the accelerated cold front, which can be traced back to a Kelvin wave. These phenomena occur in particular on the Southeast coast of Australia. One tries, using a simple model concept, to examine this behaviour of cold fronts near mountains.

15967 (NP—8751663, pp 89-93) **Forecast by means of spectral embedding.** Schmidt, F.; Klos, A. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The spectral embedding is based on a Fourier function of low period and is characterised by being free of distortion. It was tested using the example of the linearised, spatially one-dimensional potential verticity equation. Its solutions permit optimum control of the changed dispersion in consequence of the representation of the background occurrences due to the fine functions. Damping and stimulation by mountains can be included.

15968 (NP—8751663, pp 94-97) **Synoptic disturbances and climate.** Metz, W. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The mechanism of the synoptic scale stimulation of the barotropic model is able to explain by the greater part of the long term variability of the planetary modes of the atmosphere. In particular, the variation maxima observed in the medium latitudes above the Atlantic or the Pacific Ocean could be reproduced by the model. The result is a step in the direction of parametricising the effect of the synoptic disturbances on the low frequency changeability of the planetary flow.

15969 (NP—8751663, pp 98-102) **On the bimodality of flow parameters averaged over a large space.** Schilling, H.D. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

By bimodalitiy one understands two clearly separate maxima in the frequency distribution, stable against changes of the data and the classification. The occurrence of bimodality is shown for a flow parameter and a condition to which the MPL method of the histogram method is subject. The MPL method is to be preferred if the extent of the samples is small.

15970 (NP—8751663, pp 103-105) **Spectral analysis of an orographically classified area in the prefield of mesoscale flow simulation.** Schmid, S. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

A typical mountain landscape is considered as an example for the simulation of mesoscale wind systems. There is a smoothing of the given topography for the flow simulation. Using a fast Fourier transform, the Fourier coefficients of the remaining area are calculated.

15971 (NP—8751663, pp 106-108) **Cold fronts affected by orography in spectral method of consideration.** Stanek, R. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The three-dimensional spectral model takes into account the effect of orography and makes it possible to represent front profiles by Fourier methods. The front is represented as cold air flow underneath dynamically passive warm air. The model is not directed towards expensive forecast calculations.

15972 (NP—8751663, pp 109-114) **Simulation of a leecyclogenesis with a numerical model.** Tafferner, A. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The results of a numerical simulation of leecyclogeneses, which occur during the intensive measurement phase of ALPEX, are described. In examining the jet flow structure in connection with the leecyclogenesis, a strengthening of the ageostrophic wind components was found in the upper troposphere, if a jet front system advances over the Alps. Geostrophic adaptation forces seem to dominate in the first phase of the cyclogenetic development leewards.

15973 (NP—8751663, pp 115-119) **Numerical simulation of flow around New Zealand.** Ulrich, W. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01 . Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

New Zealand represents a marked isolated obstacle to flow within the Westerly wind zone of the Southern hemisphere. This is reinforced by the fact that New Zealand's mountains rise particularly steeply on the windward side. Phenomena which are easy to observe qualitatively, such as flow, leecyclogenesis and canalisation, and the upward braking (blocking) of flow can be simulated by the numerical model introduced here.

15974 (NP—8751663, pp 148-156) **Inversion of simulated satellite signals.** Kaestner, M. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

Profiles of the extinction coefficient of the atmosphere are obtained with high vertical resolution from lidar signals. Investigations on the sensitivity of inversion algorithms for backscatter lidar profiles show that the otherwise advantageous Klett algorithm has some disadvantages in the application of satellite lidar signals. The dependence of the extinction coefficient of the air layer near the ground is so great that a new inversion algorithm, an iteration, was developed, which shows a lesser dependence on the unknown a priori parameters.

15975 (NP—8751663, pp 157-160) **Role of anisotropy in the remote exploration of albedos of land surfaces.** Koepke, P. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The anisotropy of the radiation field is described by the anisotropy factor which gives the ratio of the mean radiation density to the actual radiation density dpending on the angle and which thus depends on the angles of the sun and the satellite. These parameters relevant to the climate are spectrally dependent on the properties of the ground and of the atmosphere. Examples are given of the size of the error in the ground albedo, determined from METEOSAT.

15976 (NP—8751663, pp 165-171) **Anisotropy of reflected solar radiation over different types of land surfaces.** Meerkoetter, R. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The property of a surface of reflecting radiation is described in the correct way from the spectral reflection function (BRDF). In order to be able to simulate the surfaces structuring the BRDF, it is best to take into account the superimposed effect of macrostructure

and the subordinate microstructure on the anisotropy. The developed model is suitable for simulating such superimposition. Input parameters include leaf orientation distribution and leaf thickness and also parameters which represent the microstructure.

15977 (NP—8751663, pp 181-188) **Backscatter lidar - proposed for the second German Spacelab Mission.** Quenzel, H. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01 . Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

A small backscatter lidar suitable for outer space is introduced, which is designed for use in 'Spacelab' and may fly in the German D2 Mission. The use in a short shuttle mission is ideal, in order to test the possibility of measurement of a space lidar and to estimate what development work has to be done for an operational lidar to be used on satellites.

15978 (NP—8751663, pp 208-213) **Computer evaluation of interferograms of the MIPAS laboratory model (LM).** Voelker, W. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The product of measurements of MIPAS-LM working as a Fourier spectrometer is an interferogram, which is deposited as a digitalised data sentence on a storage medium (memory). Due to the sampling method and the incompleteness of the instrumentation, the interferogram is not symmetrical. The interferogram can only be subject to a Fourier transformation (FT) after passing through a correction process, where the FT supplies the required spectral information.

15979 (NP—8751663, pp 214-220) **Iterative beam density model at the MIM.** Wiegner, M. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The radiation transport model concerns the short wave part of the spectrum in which the thermal radiation can be neglected. Multiple scatter is however, neglected. This is an iterative process which, like the matrix operator process, is regarded as exact. The MS model can be used universally.

15980 **Sensitivity of a trajectory model to the spatial and temporal resolution of the meteorological data during CAPTEX.** Draxler, R.R. (Air Resources Laboratory, National Oceanic and Atmospheric Administration, Silver Spring, MD 20910). *Journal of Applied Meteorology;* **26**: No. 11, 1577-1588(Nov 1987).

Some recent analyses of long-range transport and dispersion indicated conflicting results regarding the improvement in trajectory calculations when either the spatial or temporal density of the meteorological data are enhanced. Tests conducted with a variety of combinations of meteorological data, collected during CAPTEX, showed that increased temporal resolution did increase trajectory accuracy; however, it was not significantly different from enhancing the spatial coverage. Trajectory error was assumed to equal the distance between the centroid locations of the measured and calculated air concentration patterns. The most accurate trajectories were calculated when both spatial and temporal resolution were enhanced, such that the rms trajectory error was decreased from 180 km to 154 km for travel times of 24 to 42 h. Although the inclusion of surface observations did not improve calculated trajectories, the addition of vertical motion in the trajectory calculation methodology resulted in a further reduction of trajectory error to an average of 144 km.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 13964, 13965, 13969, 13974, 14014, 14085, 14086, 14102, 14136, 14380, 14502, 14848, 14883, 14890, 15494, 15532, 15686, 15687, 15954, 16024, 16028, 16045, 16078, 16252, 16480

15981 **(AD-A—185545/1/XAB) Smoke hazards resulting from the burning of shipboard paints. Part 3. Interim report, 1 September 1981-31 August 1983.** Williams, F.W.; Powell, E.A.; Zinn, B.T. (Georgia Inst. of Tech., Atlanta (USA)). 18 Sep 1987. 47p. NTIS, PC A03/MF A01.

Investigations continued to evaluate the hazards caused by smoke formation in shipboard fires. The physical properties of the smoke particulates generated during combustion were determined for two types of paints used by the U.S. Navy in ships and submarines. These were a chlorinated alkyd paint and and intumescent paint. The physical properties measured were particle size distribution, mean particle diameter, mass fraction of fuel converted to particulates, optical density, particle refractive index, and particulate volume fraction. The dependence of these properties on the temperature of the test-chamber atmosphere (room temperature to a maximum of 300°C) and the mode of combustion (flamming or smoldering) was determined for both materials. The results of this study indicated that both paints produce smoke with a log-normal particle size distribution during smoldering combustion in the room temperature tests. Optical measurements made during these tests show that both paints produce smoke particulates with mean diameters that vary with time between 0.6 and 1.2 microm. Under these conditions the chlorinated alkyd paint produces pale yellow spherical liquid droplets, while the intumescent paint produces a mixture of light tan and white solid particles.

15982 (CONF-8703206—, pp 166-182) **Remote transport of air impurities.** Klug, W. (Technische Hochschule Darmstadt, Germany, F.R. Inst. fuer Meteorologie). 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751688/JAW.

From 30. anniversary of the VDI Commission on air pollution prevention; Duesseldorf, F.R. Germany (17 Mar 1987).

Schriftenreihe der VDI-Kommission Reinhaltung der Luft.; v. 6.

The fact that there is remote transport of impurities in the air has been known to metereologists since the end of last centruy. Examples of this are mentioned. Starting from the observation of a continuous reduction of the pH values in South Scandinavian water courses, the first observations on the remote transport of air impurities in West Germany are described. Finally, model calculations are submitted for the spread of sulfur dioxide in Europe, which make it possible to estimate the contribution to deposition in one country from other individual countries.

15983 (CONF-8703206—, pp 183-199) **On the minimum chimney height for accidents.** Manier, G. (Technische Hochschule Darmstadt, Germany, F.R.. Inst. fuer Meteorologie). 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751688/JAW.

From 30. anniversary of the VDI Commission on air pollution prevention; Duesseldorf, F.R. Germany (17 Mar 1987).

Schriftenreihe der VDI-Kommission Reinhaltung der Luft.; v. 6.

The work of the Main Committee II which is now called 'Transport and turbulent diffusion' is described. Its tasks are as follows: As laid down in the Clean Air Technical Guide, the loading by harmful substances caused by one or several sources, is to be determined as the yearly average and as a frequency distribution using a model calculation. So that the meteorological parameters should be correctly measured, several working parties are concerned with the measurement of meteorological parameters, where the modern technical possibilities such as Doppler-Sodar and sound anemometry are taken into account. The source configurations are very different and the strength of the sources is time-dependent when treating vehicle emission and accidents. In order to determine the concentrations very extensive model calculations have to be developed for simulating meteorological fields and to determine the spread of pollutants.

15984 (CONF-8703206—, pp 247-270) **Measurement and assessment of immission of suspended dust.** Laskus, L. (Bundesgesundheitsamt, Berlin, Germany, F.R. Inst. fuer Wasser-, Boden- und Lufthygiene). 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751688/JAW.

From 30. anniversary of the VDI Commission on air pollution prevention; Duesseldorf, F.R. Germany (17 Mar 1987).

Schriftenreihe der VDI-Kommission Reinhaltung der Luft.; v. 6.

The Clean Air Commission has been an independent technical section of the Association of German Engineers (VDI) for 30 years. This is the reason why the present state of precipitation and suspended dust measurement technique is described, with a backward glance to the origin of the Commission from the former VDI Group on 'Dust Technology'. Relevant aspects of the health assessment of dust immission are also sketched out.

15985 (CONF-8703206—, pp 271-293) **Recording emission measurement technology.** Luetzke, K. (Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen, Germany, F.R.). 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751688/JAW.

From 30. anniversary of the VDI Commission on air pollution prevention; Duesseldorf, F.R. Germany (17 Mar 1987).

Schriftenreihe der VDI-Kommission Reinhaltung der Luft.; v. 6.

For certain plant, the law requires the recorded monitoring of emission with automatic assessment of the results in the Industrial Furnaces Ordinance and in Clean Air Technical Guide (TA Luft). This measuring equipment must be calibrated and subjected to an annual functional test. Further details on the method of calibration are given in both the orders. Technical Codes of Practice are required to ensure comparability of measured emission data through-out the German Federal Republic and to avoid errors.

15986 (CONF-8710238—2) **Pollutant deposition to individual leaves and plant canopies: Sites of regulation and relationship to injury.** Taylor, G.E. Jr.; Baldocchi, D.D.; Hanson, P.J. (Oak Ridge National Lab., TN (USA); National Oceanic and Atmospheric Administration, Oak Ridge, TN (USA)). 1987. Contract AC05-84OR21400. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002787/JAW.

From Assessment of crop loss from air pollutant; Raleigh, NC, USA (25 Oct 1987).

The objective was twofold: (1) to characterize the processes governing the deposition of pollutants to individual leaves and plant canopies and (2) to relate deposition to the pollutant's effects on a plant's physiology and growth. The focus is principally dry deposited, regionally distributed gases of importance because of either their phytotoxicity (e.g., ozone, O_3; sulfur dioxide, SO_2; nitrogen dioxide, NO_2; peroxyacetyl nitrate, PAN; hydrogen sulfide, H_2S; hydrogen peroxide, H_2O_2) or influence on biogeochemical cycling in terrestrial ecosystems (e.g., carbonyl sulfide; COS; ammonia, NH_3; nitric acid vapor, HNO_3). Where appropriate, the sedimentation of particles and the interception of cloud water by plant canopies and individual leaves are discussed.

15987 (DOE/ER/60293—2) **[Chemistry of atmospheric precipitation at Lewes, Delaware as part of the MAP3S study]: Annual technical progress report: Amendment No. A002.** (Delaware Univ., Newark (USA). Coll. of Marine Studies). 1987. Contract FG02-85ER60293. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88002514/JAW.

Qualitatively, results of our acid precipitation studies to date are consistent with other inland MAP3S sites, with an observed summer maximum in acidity reflecting seasonal peaks in the two major acid components. Quantitatively, the long-term volume-weighted proton concentration is 46.1 μ equiv.l^{-1}, which corresponds to a pH of 4.34. For the same period, the concentration of excess, non-marine SO_4^{-2} and NO_3^- are 42.1 and 20.2 μ equiv.l^{-1}, respectively. In examining the long-term data record, there do not appear to be any systematic trends for precipitation acidity or either acid anion. Variation in the excess SO_4^{-2} concentration seems to be most directly responsible for changes in precipitation acidity, while the NO_3^{-2} concentration has exhibited little year-to-year variability. Observed concentrations of the acid components are apparently independent of the precipitation amount via a washout or dilution effect. Our investigations on the incorporation of marine aerosols in local precipitation have revealed that sea-salt derived SO_4^{-2} comprises only an average of about 14% of the total sulfate. Within the past year we have introduced our entire MAP3S major ion data base by event onto a computer file, and merged this file with our trace element data. This comuputerization has provided a more practical way to store, edit, and retrieve in excess of 600 events collected at our Lewes MAP3S site.

15988 (DOE/ER/60493—1-Vol.1) **Indoor air '87: Volume 1, Volatile organic compounds, combustion gases, particles and fibres, microbiological agents.** Seifert, B.; Esdorn, H.; Fischer, M.; Rueden, H.; Wegner, J. (eds.). (Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene; Technische Univ. Berlin (Germany, F.R.). Hermann Rietschel Inst. of Heating and Air Conditioning; Freie Univ. Berlin (Germany, F.R.). Inst. of Hygiene). 1987. Contract FG02-86ER60493. 732p. (CONF-870853—Vol.1). NTIS, PC A99. Order Number DE88004513/JAW.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Individual articles are processed for the databases. (PSB)

15989 (DOE/ER/60493—1-Vol.3) **Indoor air '87: Volume 3, Developing countries, guaranteeing adequate indoor air quality, control measures, ventilation effectiveness, thermal climate and comfort, policy and strategies.** Seifert, B.; Esdorn, H.; Fischer, M.; Rueden, H.; Wegner, J. (eds.). (Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene; Technische Univ. Berlin (Germany, F.R.). Hermann Rietschel Inst. of Heating and Air Conditioning; Freie Univ. Berlin (Germany, F.R.). Inst. of Hygiene). 1987. Contract FG02-86ER60493. 596p. (CONF-870853—Vol.3). NTIS, PC A25. Order Number DE88004515/JAW.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Individual papers are processed separately for the databases. (PSB)

15990 (DOE/ER/60493—1-Vol.4) **Indoor air '87: Volume 4, Plenary lectures, index.** Seifert, B.; Esdorn, H.; Fischer, M.; Rueden, H.; Wegner, J. (eds.). (Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene; Technische Univ. Berlin (Germany, F.R.). Hermann Rietschel Inst. of Heating and Air Conditioning; Freie Univ. Berlin (Germany, F.R.). Inst. of Hygiene). 1987. Contract FG02-86ER60493. 145p. (CONF-870853—Vol.4). NTIS, PC A07. Order Number DE88004516/JAW.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Individual papers are processed separately for the databases. (PSB)

15991 (DOE/NBM—8003901) **NAPAP [National Acid Precipitation Assessment Program] operating research plan, 1986-1988.** Downing, R.J. (ed.). (National Acid Precipitation Assessment Program, Washington, DC (USA). Office of the Director of Research). 1986. 478p. NTIS, PC A21/MF A01; 1; GPO Dep. Order Number DE88003901/JAW.

The goal of the National Acid Precipitation Assessment Program (NAPAP) is to develop and progressively refine an objective and comprehensive body of information on the causes and effects of acidic deposition. The program includes research, monitoring and assessment activities that emphasize the timely development of a firmer scientific basis for decisionmaking by legislators, regulatory officials, resource managers, environmental groups, and the public. The National Program consists of almost 300 ongoing projects funded by six federal agencies in seven major areas of research. This document is used by NAPAP management to plan and imple-

ment this comprehensive research effort. The information contained in the plan will guide NAPAP and its member agencies in refining research goals, proposing new initiatives, and developing the annual NAPAP interagency budget. Each Task Group chapter of the Operating Plan consists of a textual overview of the scope of the Task Group's research effort; a summary of major Task Group deliverables and their anticipated dates of completion; a tabular summary of all ongoing research projects and their funding; and individual project descriptors outlining the performer(s), duration, funding history, objectives, work plan, and deliverables for each project.

15992 **(EPRI-EA—5571) Proceedings: EPRI air quality modeling contractors meeting.** Johnson, W.B.; Viezee, W.; Ludwig, F.L. (SRI International, Menlo Park, CA (USA). Atmospheric Science Center). Dec 1987. 128p. (CONF-8602157—). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920141/JAW.

From EPRI air quality modeling contractors meeting; Palo Alto, CA, USA (25 Feb 1986).

A meeting of EPRI-funded air-quality modelers and experimentalists was held to exchange technical information between the two groups of investigators. Presentations were made by groups of modelers. Modelers can assist experimentalists by building tracers into Eulerian models so that comparisons with observations can be facilitated. Experimentalists can help modelers by indicating where model development can use simplified approaches. The different time and space steps in models and observational studies were discussed. Models primarily deal with grid averages, while observations involve point values. Models are often designed to five episodic predictions. In contrast, experiments can generate results for years. Further work is required to characterize uncertainties in model calculations, including such items as input data, mathematical representation of atmospheric processes, and measurements for evaluating model performance. Individual papers are processed separately for the the data base.

15993 **(GKSS—87/E/20) Concept, design and experimental evaluation of a Raman-lidar polychromator for simultaneous remote measurement of carbon dioxide and water vapor relatively to oxygen.** Voss, E. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Hamburg Univ. (Germany, F.R.). Fachbereich Physik; GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1987. 160p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751670/JAW.

For Raman lidar measurements of high profiles of CO/sub 2/ and H/sub 2/O, a device for wavelength separation is needed. The paper describes a polychromator specially designed for this purpose. Some theoretical studies for the selection of plane gratings, imaging elements, and the arrangement of the components are given. Experiments with the optical elements are described, including extensive efficiency measurements for the gratings. The alignment and calibration procedure for the apparatus is presented in detail. The most important properties of the polychromator are measured and their dependence on several parameters is determined. The perturbation of the CO/sub 2/-channel count rate is calculated, and Raman spectra from CO/sub 2/, H/sub 2/O and O/sub 2/ are measured. The suitability of the presented device is demonstrated. With 68 figs., 20 tabs..

15994 **(INIS-mf—10779) Greenhouse effect and climate. Present state and prospects (revised and extended in Autumn 1987).** Flohn, H. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1987. 20p. (In German). (CONF-871067—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751510/JAW.

From Meeting of the Society for Reactor Safety; Cologne, F.R. Germany (29 Oct 1987).

Model calculations with different marginal conditions and different physical processes do, on the basis of realistic assumptions, result in a temperature rise of 3 +- 1.5degC at doubling carbon dioxide concentrations. Temperatures are increasing even more due to the presence of trace gases contributing to the greenhouse effect. They are assumed to be having a share of 100% in the carbon dioxide effect (additive) in 30-40 years from now. According to the model calculations the CO/sub 2/ increase from about 280 ppm around 1850 to 345 ppm (1985) is equal to a globally averaged temperature rise of 0.5-0.7degC. As the data obtained before 1900 were incomplete and little representative climatic analyses cannot be considered to have been effective but after that time. However, considering the additional influence of other climatic effects such as vulcanism the temperature rise satisfactorily corresponds to the values obtained since 1900.

15995 **(KFK-PEF—21) Evaluation of hourly SO/sub 2/- and NO/sub x/-emissions in Baden-Wuerttemberg in a spatial resolution of 1x1 km for the period of the TULLA measuring-campaign.** Boysen, B.; Friedrich, R.; Mueller, T.; Scheirle, N.; Voss, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre; Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Mar 1987. 91p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751669/JAW.

The aim of this study was to establish an emission inventory of SO/sub 2/ and NO/sub x/ for the state of Baden-Wuerttemberg for the period of the TULLA experiment. The emissions were calculated for every hour during this period and in the scale of 1x1 kilometer. Different methods to evaluate the emissons were applied: All power-plants and other major emittents (mainly of the industry-sector) with furnaces greater 10 MW were asked to give the amount of hourly emissions directly, or if not possible, the hourly energy consumption. In this campaign about 330 plants were included. For all other emittents including private households and the transportation-sector models were developed to calculate the time-dependent emissions based on exogeneous parameters such as housing-data, yearly energy-consumption-data, temperature, economic data etc. With 34 figs., 14 refs..

15996 **(LBL—22724) The role of analytical chemistry in assessing atmospheric effects of combustion.** Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 52p. (CONF-870954—1). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003909/JAW.

From EUROANALYSIS VI: European conference on analytical chemistry; Paris, France (7 Sep 1987).

This paper discusses sampling and analysis strategies designed to distinguish local and regional sulfate and to identify heterogeneous SO_2 oxidation in an urban heavily polluted atmosphere. The role of analytical chemistry will be illustrated by reviewing the results of a multi-year international cooperative study conducted principally in Ljubljana, Yugoslavia. The analytical results, when combined with physical measurements and meteorological data, have enabled us to assess the role of combustion effluent in SO_2 oxidation and to infer the interrelationship between the chemical and physical properties of the atmosphere. The conclusions from field measurements about the SO_2 oxidation process were verified by laboratory cloud chamber experiments designed to simulate the conditions encountered in a source-dominated atmosphere. 17 refs., 17 figs., 4 tabs.

15997 **(NILU-OR—3/86) Review of papers published in 1985 about emission, transport, transformation and deposition of atmospheric trace constituents of importance for acid deposition.** Hov, Oe. (Norsk Inst. for Luftforskning, Lillestroem). Feb 1986. 61p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751200/JAW.

About 300 papers published in 1985 or later in 1984 have been reviewed. There has been progress in the development of models for acid deposition and photochemical oxidants. Simultaneous measurements of O/sub 3/, NO/sub x/, individual hydrocarbons, aldehydes, CO and OH have lead to the conclusion that the atmospheric gas chemistry in moderately polluted air is well understood. There is an upward trend over Europe in the concentration of methane, CO and O/sub 3/. Ca 300 refs.

15998 (NILU-OR—34/87) **Acid precipitation literature review 1986. Emission, transport, transformation and deposition of acidic trace species.** Hov, Oe. (Norsk Inst. for Luftforskning, Lillestroem). May 1987. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751208/JAW.

More than 230 scientific papers on topics related to acid deposition published in 1986, are referenced and reviewed.The main subjects are trends in acid deposition, acid substances in the remote troposphere reaction kinetics, deposition processes, measurements, analytical techniques, emissions, models, interpretations of measurements. Ca. 230 refs., 3 figs., 1 table.

15999 (NP—8751663, pp 129-134) **Investigations on the effect of chemical reactions on vertical flows of gaseous and particle compounds.** Dlugi, R. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The importance of chemical reactions for calculating the deposition of H/sub 2/SO/sub 4/, (NH/sub 4/)/sub 2/SO/sub 4/, HNO/sub 3/, NH/sub 4/NO/sub 3/ and NH/sub 3/ and the total sulfate and total nitrate is examined. Using the gradient method and the Bowen ratio method, the vertical flows and speeds of deposition are calculated. The effect of chemical reactions and different micro-meteorological methods for calculating the turbulent exchange coefficients of these parameters was also examined.

16000 (NP—8751663, pp 172-180) **Remote exploration of trace gases - special aspects of emission spectroscopy.** Oelhaf, H. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

One can expect consistency from the horizontal sounding of stratospheric trace gases in the Earth's atmosphere, particularly for the gases CO/sub 2/, H/sub 2/O and CO. In inversion of spectral measurements in trace gas concentrations, the modelling of atmospheric layers far from the tangential point and the accuracy of the basic atmospheric profiles are of great importance. The investigations in the context of the MIPAS project on radiation transmission and data interpretation include the problems of sounding lines of large optical thickness.

16001 (NP—8751663, pp 193-199) **Anthropogeneous influences on the process of drop formation and ion concentrations in drops.** Seidl, W. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The ion concentrations in the drops, particularly the pH value, determine the chemical reactions and the dissolving of trace gases such as SO/sub 2/ for example, in the drops. In order to obtain basic data for the calculation of chemical reactions in drops, concentrations of ions in drops of different sizes are calculated, where only the ions present in the aerosol particles were taken into account. Anthropogeneous influences on the drop spectrum exist in cumulonimbus.

16002 (NP—8751663, pp 200-207) **Aerosol size distribution from measurements of the beam density in the sun's aureole.** Thomalla, E. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The aerosol size distribution is among those parameters of the atmosphere, the knowledge of which is of considerable importance for many current questions, such as aerosol climatology, radiation balance, anthropogeneous effect on the atmosphere and correction of satellite measurements, for example. A passive remote exploration method is used to determine the aerosol size distribution as a mean over the vertical column of the atmosphere. The main point of the investigations is to deal with all the important questions of the information content of the measured data, the requirements for the measuring equipment and the possible accuracy of the results.

16003 (PB—88-114004/XAB) **Fundamentals of air-pollution engineering. Licentiate course in Spring 1987.** Flagan, R.; Hulkkonen, S. (Helsinki Univ. of Technology, Espoo (Finland). Lab. of Energy Economics and Power Plants). 1987. 119p. (REPT—44). NTIS, PC E05/MF A01.

In the spring 1987, a course on Air Pollution Engineering was arranged at the Helsinki University of Technology (HUT) in Otaniemi. The lectures addressed the fundamental physical and chemical principles of air pollution control. The topics covered included: the formation of pollutants in combustion systems; modifications to the combustion process to minimize pollutant formation; aerosol fundamentals; removal of gaseous and particulate pollutants from gas streams. Seven students of the course prepared and presented a scientific seminar work on a personally proposed subject dealing with the topics of the course. Their lectures are collected in the publication.

16004 (PB—88-116546/XAB) **Modeling and measurement of vehicle emissions from roadways. Volume 2. Appendix k.** (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Jul 1987. 568p. (TTI—2-8-80-283-3F-VOL-2). NTIS, PC A24.

See also Volume 1, PB—88-116538.

16005 (PB—88-118492/XAB) **Evaluation of emission factors for formaldehyde from certain wood-processing operations. Final report.** Burklin, C.E.; White, T.S. (Radian Corp., Research Triangle Park, NC (USA)). Oct 1987. 79p. NTIS, PC A05/MF A01.

A state pollution control agency requested assistance from EPA's Control Technology Center (CTC) in estimating formaldehyde emissions from furniture-manufacturing processes. These plants use urea-formaldehyde adhesive resin formulations which emit formaldehyde during application, curing, and storage. The primary sources of information for the study include library and permit data-base searches, telephone conferences, and meetings with members of the furniture- and adhesive-manufacturing industries. The report estimates emission factors for the most significant sources and discusses the impact of process variables and modifications on these emissions.

16006 (PB—88-118773/XAB) **Health problems associated with air conditioning: a study tour of the USA. Research memo.** Brundrett, G.W.; Eddyshaw, J. (Electricity Council Research Centre, Capenhurst (UK)). Jun 1987. 21p. (ECRC/M—2152). NTIS, PC E04/MF E04.

Two popular worries are creating an exaggerated public suspicion of air-conditioned buildings. The first is the growing frequency of Legionnaire's disease epidemics. Although in practice these are linked with wet cooling towers and not air conditioning, this distinction is not normally recognized. The second is the sick-building syndrome. Recent British work shows that one-third of the occupants of typical air-conditioned buildings are unhappy. This is consistent with American experience. The report describes a study tour to the USA to survey the leading authorities to seek guidance on how the problem was being tackled in a country where air conditioning is much more common and has longer standing.

16007 (PB—88-120845/XAB) **Evaluation of potential emissions of TDI (toluene diisocyanate) from two facilities. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Oct 1987. 40p. (EPA—450/3-87/022). NTIS, PC A03/MF A01.

Two facilities which use toluene diisocyanate (TDI) were inspected by EPA at the request of a county air pollution control agency. The inspections were performed to identify potential sources of routine and accidental releases of TDI. The report presents the results of the inspections.

16008 **(PB—88-120860/XAB) Meteorological and aerosol measurements from the NOAA WP-3D aircraft during WATOX-86, January 4-9, 1986. Technical memo.** Bridgman, H.; Stunder, B.; Artz, R.; Rolph, G.; Schnell, R. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Jul 1987. 76p. (NOAA-TM-ERL-ARL—156). NTIS, PC A05/MF A01.

On January 4, 6, 8, and 9, 1986, a series of NOAA WP-3D research flights were conducted over the Western Atlantic Ocean, 2-300 km off the coast of North America. Flights were made perpendicular to NW airflow to establish the flux of gas and aerosol emissions from the east coast of North America. The following details are presented for each flight: a horizontal projection of the flight track on a latitude-longitude grid; the relevant synoptic situation; air-parcel back-trajectories; a flight log; vertical cross sections of potential temperature, mixing ratio, and flight track; vertical cross sections of condensation nuclei (CN) and aerosol scattering extinction (b sub sp); and representative aerosol size distributions.

16009 **(PB—88-121629/XAB) Particulate monitoring for acid-deposition research at Sequoia National Park, California. Final report.** Cahill, T.A.; Annegarn, H.J.; Ewell, D.; Feeney, P.J. (California Univ., Davis (USA). Crocker Nuclear Lab.). May 1986. 127p. NTIS, PC A07/MF A01.

The objectives of the project were: (1) to characterize the particulate composition of fine particles; (2) to determine what material is available for wet and dry deposition (3) to determine how particulate concentrations vary with time as the methodology changes; (4) to determine the extent of transport of particulate pollutants from the San Joaquin Valley; (5) to provide convenient time plots and other visual representations of particulate concentrations to concurrent projects on the effects of wet and dry deposition and to studies dealing with meteorology and gases.

16010 **(PB—88-122577/XAB) Program for Operational Trajectories (POT). Technical memo.** Heffter, J.L.; Stunder, B.J.B. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Aug 1987. 18p. (NOAA-TM-ERL-ARL—157). NTIS, PC A03/MF A01.

The Program for Operational Trajectories was developed at the NOAA Air Resources Laboratory to be used for emergency response or field operations. The program can be used to determine diagnostic (analyzed), prognostic (forecast), or linked diagnostic-prognostic long-range trajectories anywhere in the Northern Hemisphere from wind fields stored on disk files at the National Meteorological Center in Suitland, MD. Various models that constitute POT are discussed, and a complete set of operating instructions is presented along with examples of input and output.

16011 **(PB—88-123955/XAB) UNAMAP - User's Network for the Applied Modeling of Air Pollution. Report for July-October 1987.** Pierce, T.E.; Turner, D.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Oct 1987. 8p. (EPA—600/D-87/330). NTIS, PC A02/MF A01.

See also version 6, PB—86-222361.

The Users' Network for the Applied Modeling of Air Pollution (UNAMAP) was initiated by EPA in 1973. It was conceived as a means of distributing air-pollution models to a variety of organizations around the country. Since 1973, UNAMAP has grown from 6 models to 23 models. The report provides a brief description of the UNAMAP system. It also discusses the impact that changes in National Weather Service meteorological data will have on air-pollution models.

16012 **(PB—88-124086/XAB) Assessment of airborne exposure and dermal contact to acrylamide during chemical grouting operations. Final report.** McHugh, J.M. (Midwest Research Inst., Kansas City, MO (USA)). 22 Jul 1987. 130p. (MRI—8850-A(01)). NTIS, PC A07/MF A01.

Acrylamide exposure may occur by inhalation, ingestion and skin absorption; acrylamide is a neurotoxin and an irritant. The report details the results of field studies to assess airborne exposure and dermal contact to acrylamide during chemical grouting operations. Occupational exposures to acrylamide were characterized for sewer mainline, lateral line, and manhole maintenance operations. The objective of the study was to collect exposure data based on observations and measurements to be used as an integral part of a quantitative risk assessment by the U.S. Environmental Protection Agency's Office of Toxic Substances.

16013 **(PB—88-124292/XAB) Analysis of acid-precipitation samples collected by state agencies. Annual report.** McCracken, R. (Global Geochemistry Corp., Canoga Park, CA (USA)). Nov 1987. 503p. NTIS, PC A22/MF A01.

This report summarizes the analytical results from 30 state operated wet acid deposition sites. All sites submitted their samples to the same laboratory so that comparisons of data could be made from different geographic areas. The use of a central laboratory also provided cost efficiencies and improved documentation of data quality. The report contains maps showing the location of each site, plots of analytical data during the time period, tables of all field and analytical data, a table comparing the concentration of each analyte at the different sites, a table of precipitation-weighted data for each site, plots comparing field and laboratory pH and conductivity measurements, and quality-control tables and plots giving information on overall data quality.

16014 **(PB—88-124300/XAB) Supercritical fluid extraction-gas chromatography of volatile organic compounds (VOC) from Tenax devices. Final report, November 1985-September 1986.** Wright, B.W.; Kopriva, A.J.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. 80p. (REPT—2311107118). NTIS, PC A05/MF A01.

This report describes the development and evaluation of on-line supercritical-fluid extraction - gas-chromatography instrumentation and methodology for the analysis of volatile organic compounds (VOC) from adsorbent sampling devices. Supercritical fluid extraction offers potential advantages for the removal and transport of organic components from adsorbent matrices including rapid and efficient extraction at mild temperatures. Extraction at mild temperatures eliminates potential problems such as analyte decomposition that can be encountered with the high temperatures needed for thermal desorption analysis. Since a major objective of the study was to develop viable instrumentation and methodology, a relatively detailed description of the instrumentation design requirements and present limitations are discussed. The results of several series of methodology validation studies are also presented. These studies included recovery studies of model VOC spiked on three types of Tenax sampling devices including authentic actively pumped (VOST) and passive (EPA) devices. Replicate devices spiked in an exposure chamber were also subjected to parallel analyses using the new methodology and traditional thermal-desorption gas chromatography.

16015 **(PB—88-124615/XAB) Evaluation of sampling and analytical methods for nicotine and polynuclear aromatic hydrocarbon in indoor air. Final report, 1 February 1987-30 March 1987.** Chuang, J.C.; Kuhlman, M.R.; Hannan, S.W.; Bridges, C. (Battelle Columbus Div., OH (USA)). Nov 1987. 33p. NTIS, PC A03/MF A01.

The objective of this project was to evaluate a potential collection medium, XAD-4 resin, for collecting nicotine and polynuclear aromatic hydrocarbon (PAH) and to determine whether one collection system and one analytical method will allow quantification of both compound classes in air. The extraction efficiency study was to determine the extraction method to quantitatively remove nicotine and PAH from XAD-4 resin. The results showed that a two-step Soxhlet extraction consisting of dichloromethane followed by ethyl acetate resulted in the best recoveries for both nicotine and PAH. In the sampling efficiency study, XAD-2 and XAD-4 resin were compared, in parallel, for collection of PAH and nicotine. Quartz fiber filters were placed upstream of both adsorbents to collect particles. Prior to sampling, both XAD-2 and XAD-4 traps were spiked with known amounts (2 microgram) of perdeu-

terated PAH and D3-nicotine. The experiments were performed with cigarette smoking and nonsmoking conditions. The spiked PAH were retained well in both adsorbents after exposure to more than 300 cu. m. of indoor air. The spiked XAD-4 resin gave higher recoveries for D3-nicotine than did the spiked XAD-2 resin. The collection efficiency for PAH for both adsorbents is very similar but higher levels of nicotine were collected on XAD-4 resin.

16016 **(PB—88-124755/XAB) Health effects associated with indoor air pollutants.** Ammann, H.M.; Berry, M.A.; Childs, N.E.; Mage, D.T. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). Oct 1987. 23p. (EPA—600/D-87/324). NTIS, PC A03/MF A01.

A state-of-information survey concerning health effects of indoor air pollutants in the categories of formaldehyde, volatile organics, radon, particulates, and combustion products was prepared by the U.S. Environmental Protection Agency's Environmental Criteria and Assessment Office, RTP, N.C. Included in each category are human effects, animal exposure experiments, mutagenicity, and carcinogenicity information. In addition to those health implications associated with each category of pollutants, the problems of measuring exposure to the complex mixtures actually breathed by people in homes is addressed.

16017 **(PB—88-125265/XAB) Assessing the performance of ambient air samplers for volatile organic compounds.** Crist, H.L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). Oct 1987. 18p. (EPA—600/D-87/327). NTIS, PC A03/MF A01.

Performance-audit results of two different ambient-air-monitoring projects for volatile organic compounds (VOC's) are presented. An NBS traceable gas cylinder containing several VOC's in dry nitrogen at parts per billion (ppb) concentration levels was used at the field-sampling site to evaluate performance of the sampling and analytical systems. Both Tenax cartridges and evacuated stainless steel canisters (6 litre) were used to sample the air. Sample media exposed to the audit gas were returned to the laboratory for analysis.

16018 **(PB—88-125554/XAB) Potential contribution of sulfate production in cumulus-cloud droplets to ground-level particle-sulfur concentrations.** Altshuller, A.P. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1987. 11p. (EPA—600/J-87/076). NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 21, No. 5, 1097-1105(1987).

Relationships were examined between the presence or absence of cumulus clouds and 3rd-quarter fine-particle sulfur concentrations in St. Louis. An association between the presence of cumulus clouds with SO_2 conversions in droplets and incrementally higher fine-particle sulfur concentrations can be demonstrated. However, diurnal patterns of fine-particle sulfur concentrations in the presence of cumulus clouds are not consistent with local contributions from sulfate formation in cumulus clouds. Morning fog often occurs on the same days on which cumulus clouds form later. Reactions of SO_2 in fog droplets appear to make a contribution, but do not account for the major part of the increments in fine-particle-sulfur concentrations associated with cumulus clouds.

16019 **(PB—88-125661/XAB) Isoprene-emission fluxes determined by an atmospheric-tracer technique.** Lamb, B.; Westberg, H.; Allwine, G. (Washington State Univ., Pullman (USA)). 1986. 10p. NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 29, No. 1, 1-8(Jan 1986).

Sulfur hexafluoride tracer was used in a series of experiments to simulate isoprene emissions from an isolated oak grove. The measured tracer release rate and ambient concentrations of isoprene and SF_6 observed along downwind sample lines were combined to determine the mass flux of isoprene from the forest. The fluxes determined from the tracer data increased exponentially with temperature and were in close agreement with estimates determined from emission rates measured in a series of branch-enclosure samples. The results of the field study demonstrate the feasibility and usefulness of simulating forest emissions as a tool for investigating turbulent transport in forested areas. Isoprene emission fluxes that can be applied in regional models are reported.

16020 **(PNL-SA—14990) Transpiration's inhibition of air pollution fluxes to substomatal cavities.** Slinn, W.G.N. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 13p. (CONF-8709149—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003401/JAW.

From 8. conference on biometeorology and aerobiology; West Lafayette, IN, USA (15 Sep 1987).

This report presents an estimate for the resistance to transport through stomatal openings, accounting for the counterflowing flux of water vapor associated with transpiration. The specific goal of this report is to estimate the influence of transpiration on the stomatal resistance, r/sub sto/; others have estimated the substomatal and mesophyll resistances r/sub ssc/ and r/sub mes/. It might be expected that any influence of the water-vapor flux on pollutant transport would be a maximum at the stomatal opening since, at the constricted area of the stoma, the water flux is a maximum. Transpiration through stomata appears to insigifnicantly inhibit the passage of relatively small molecules (e.g., SO_2, O_3, HNO_3, PAN, etc.) through the stomata, and therefore, by entering the substomatal cavity, such pollutants have greater potential for threatening plan survival, if their concentrations are excessive. 7 refs., 5 figs.

16021 **(UCID—21178) Initial results with the LLNL 2-D chemical-radiative-transport model of the troposphere and stratosphere.** Wuebbles, D.J.; Connell, P.S.; Grant, K.E.; Tarp, R.; Taylor, K.E. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004355/JAW.

Significant progress has been made at LLNL in the development of a zonally averaged (two-dimensional) chemical-radiative-transport model of the troposphere and stratosphere. Although further model development and refinement is being planned the LLNL 2-D model is currently ready to be applied to appropriately designed research studies of stratospheric chemical processes and interactions. Several such studies are now underway. This paper provides a description of the existing 2-D model and discusses some of the pertinent results for evaluating the capabilities of the model. Special attempts at improving the timing of the model are also discussed. 6 figs.

16022 **Statistical methods for environmental pollution monitoring.** Gilbert, R.O. New York, NY; Van Nostrand Reinhold Co. Inc. (1987). 384p. Van Nostrand Reinhold Co. Inc., 115 Fifth Ave., New York, NY 10003.

In this work the author explains statistical methods for designing environmental sampling and monitoring programs, and analyzing the results. The work discusses how to estimate average levels of pollutants, characterize the variability of pollution measurements collected in space and time, and detect localized areas (hot spots) of elevated concentration levels. Other topics of interest include computing confidence limits on means and medians, data transformations, handling concentrations near measurement detection limits, and more.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 14637, 15421, 16054, 16203, 16220, 17170

16023 **(ANS—595-7) ECOS - analysis of sensitivity to database and input parameters.** Sumerling, T.J.; Jones, C.H. (Associated Nuclear Services, Epsom (UK); Department of the Environment, London (UK)). Jun 1986. 116p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750849/JAW.

The sensitivity of doses calculated by the generic biosphere code ECOS to parameter changes has been investigated by the authors for the Department of the Environment as part of its radioac-

tive waste management research programme. The sensitivity of results to radionuclide dependent parameters has been tested by specifying reasonable parameter ranges and performing code runs for best estimate, upper-bound and lower-bound parameter values. The work indicates that doses are most sensitive to scenario parameters: geosphere input fractions, area of contaminated land, land use and diet, flux of contaminated waters and water use. Recommendations are made based on the results of sensitivity.

16024 **(CEA-CONF—8930) Interpretation of the Thorney Island phase 1 trials with the box model Cigale2.** Crabol, B.; L'Homme, V.; Roux, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Sep 1986. 35p. (CEA-DAS—294; CONF-8609371—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751534/JAW.

From Symposium on analysis and interpretation of results of the Thorney Island trials; Sheffield, UK (23 Sep 1986).

Atmospheric heavy gas dispersion is one of the important phenomena participating in the risk of external events against nuclear installations or in the hazard represented by the classical industries against the environment. These problems, both relevant to the CEA/IPSN, have been the subject of specific studies for some years. Three different ways of approach of these problems have been developed, or are under development: box modelling, three dimensional modelling and small-scale simulation in water channel. The aim of this paper is to present the interpretation of the Thorney Island phase 1 trials with the box model DENZ and the consequent development of the improved box model CIGALE2. This work was done under contract with the Environment Ministry. This paper is a summary of the final report of this contract.

16025 **(CEA-CONF—9005) Assessment of the environmental impact of a tritium gas release: resuspension of HTO from soil surface.** Belot, Y.; Guenot, J.; Djerassi, H.; Gulden, W.; Clerc, H. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Nov 1986. 19p. (CONF-861143—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751331/JAW.

From IAEA technical committee meeting on fusion reactor safety; Culham, UK (3 Nov 1986).

A fraction of the tritium gas released to atmosphere can be rapidly oxidized at the surface of soil, and then resuspended to atmosphere as HTO. Since tritiated water is more radiotoxic than tritium gas, we need to calculate the concentrations of HTO which may occur in the atmosphere during and after the release of tritium gas. This can be achieved if we know the deposition rate of tritium gas and the rate at which the deposited tritium is resuspended to atmosphere. The resuspension rate has been determined by mathematical modelling and experimental simulation. The soil-plant system is assumed to consist of N soil layers and one plant compartment. The tritiated water content of the soil and the plants is described by a system of simultaneous, first-order, linear, differential equations with discontinuous, variable coefficients. The coefficients are derived from the phenomenological equations of transfer processes at plant and soil surfaces and through the soil profile. The parameters needed as entry to the model are water vapor concentrations at soil-atmosphere interface, soil moistures and water fluxes at different depths in the soil. The resuspension rate, defined as the fraction of the deposited HTO which is resuspended per unit time, is computed from the evolution of HTO content in the totality of soil profile. In parallel to the development of the model, an experimental simulation was done to determine the resuspension rate and its evolution during a period of 10 days, by covering a small area of undisturbed soil by a field chamber, exposing the enclosed soil to tritium gas, then flushing the chamber at a high flow rate and collecting periodically the resuspended tritiated water. The model and experimental values of the initial resuspension rates were similar and comprised between 1 and 5 %.

16026 **(CEA-DSN—84-Rev.2) Graphs for the direct evaluation of atmospheric transfers of gaseous effluents.** Doury, A.; Gerard, R.; Picol, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Feb 1980. 110p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751725/JAW.

Sometimes, instead of use heavy and complex means, there is a need for lighter, more economical and more convenient means for predicting rapidly and quantitatively the chemical or radioactive pollutions transported and diffused by the atmosphere. The collection of graphs presented may well be one means of this type for the staff in charge of performing safety and protection calculations. The graphs were calculated from a numerical model which is in itself much more performing, but they are nevertheless compatible with it, so that the various extrapolations or interpolations they include on large distances, light and strong winds, source heights are more credible than those which result from purely experimental graphs without any intermediate modelization. Obviously, the coefficients which are used (standard deviations for matter distribution) result from experiments with tracers, but calculation aims in particular at obtaining better shapes and better extrapolations or intrapolations. The results are valid for the ground level and different point-source heights, along the average wind direction as well as crosswind. They are expressed as atmospheric transfer coefficients which allow to deduce in particular a constant concentration form a flow rate, in steady state conditions, or a concentration integrated over the time from a total amount emitted, in transient condition. Except for well-known specific cases, for instance horizontal dispersion in bad diffusion conditions, the graphs give orders of magnitude quite compatible with those resulting from a number of other methods currently in use.

16027 **(DOE/BP—900) Radon monitoring results from BPA's residential weatherization program: Report No. 6.** (USDOE Bonneville Power Administration, Portland, OR). Oct 1987. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003272/JAW.

This report provides a summary of all the data collected for the States of Oregon, Washington, Idaho, and Montana. Specific data is listed by US Geological Survey designated range and township locations. The specific data listed by range and township includes only those townships with a minimum of five radon readings. The radon measurement results contained in this report were conducted by passive alpha-track detectors. The Residential Weatherization Program requires that the detectors be placed is residence for a minimum of 3 winter months, up to 1 year in length. Due to the variations in the length of measurements, we have added a section to this report which lists the average radon values for given exposure periods. 6 figs.

16028 **(DOE/ER/60493—1-Vol.2) Indoor air '87: Volume 2, Environmental tobacco smoke, multicomponent studies, radon, sick buildings, odours and irritants, hyperreactivities and allergies.** Seifert, B.; Esdorn, H.; Fischer, M.; Rueden, H.; Wegner, J. (eds.). (Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene; Technische Univ. Berlin (Germany, F.R.). Hermann Rietschel Inst. of Heating and Air Conditioning; Freie Univ. Berlin (Germany, F.R.). Inst. of Hygiene). 1987. Contract FG02-86ER60493. 680p. (CONF-870853—Vol.2). NTIS, PC A99. Order Number DE88004514/JAW.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Individual papers are processed separately for the databases. (PSB)

16029 **(ENEA-RT-PAS—87-10) Principal radionuclide distribution of airborne particulate matter at Casaccia (Rome) following the Chernobyl accident.** Gragnani, R.; Michetti, I.; Tarroni, G.; Testa, L. (ENEA, Rome (Italy)). Jul 1987. 23 p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751911/JAW.

Results of grainsize and radionuclide distribution of airborne particulate matter are presented and discussed. The sampling was carried out, after the Chernobyl accident, by means of a high volume sampler with 5-stage cascade impactors. Focussing on health and environmental aspects, the same samples were also analyzed for some of the most important radionuclides (Ru-103, I-131, Te-132, Cs-134, Cs-137, Ba-140). The radioactivity per cent cumulative spectra against the airborne particulate grainsize gave the opportunity to obtain information on possible radionuclide association

with various particle sizes. The high radioactivity values are consistent with 1/um and, probably, submicron particles. The data obtained give useful information on the evaluation of aerosol inhalation and its probable deposition in the lungs.

16030 **(NRPB-R—198) Modelling wet deposition from a short release. The sixth report of a Working Group on Atmospheric Dispersion.** Jones, J.A. (National Radiological Protection Board, Chilton (UK)). Aug 1986. 23p. H.M. Stationery Office, London, price Pound 4.00.

This report is the sixth in a series giving practical guidance to estimate the dispersion of radionuclides released to the atmosphere. It represents the conclusions of a Working Group established to review recent developments in atmospheric dispersion modelling and to propose models for use within the U.K. This report describes the difficulties inherent in any calculation of wet deposition from a short release, identifies models for such calculations and points out the assumptions and approximations contained in those models.

16031 **(NRPB-R—199) Uncertainty in dispersion estimates obtained from the Working Group models. The seventh report of a Working Group on Atmospheric Dispersion.** Jones, J.A. (National Radiological Protection Board, Chilton (UK)). Aug 1986. 30p. H.M. Stationery Office, London, price Pound 4.00.

This report is the seventh in a series giving practical guidance to estimate the dispersion of radionuclides released to the atmosphere. It represents the conclusions of a Working Group established to review recent developments in atmospheric dispersion modelling and to propose models for use within the UK. This report examines the uncertainty inherent in predictions of atmospheric dispersion made with models recommended by the Group. It identifies the number of sources of uncertainty, such as the random nature of atmospheric dispersion, the idealisations inherent in modelling and the choice of values for the many parameters involved. The report puts these uncertainties in context and comments on the reliability of models for use in practical situations.

16032 **(PB—88-855218/XAB) Radon detection in homes and buildings. January 1970-December 1987 (citations from the NTIS data base). Report for January 1970-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 67p. NTIS PC N01/MF N01.

Supersedes PB—87-850038.

This bibliography contains citations concerning the detection of radon and radon daughter gases in homes and buildings. Measurement techniques and equipment, the effect of local geology on radon in a building, the effect of home-weatherization measures on radon levels, and sources of radon entering buildings are among the topics discussed. Residential and non-residential buildings are examined. Risk assessment and ways to control the amount of radon in a building are briefly considered. (This updated bibliography contains 123 citations, 37 of which are new entries to the previous edition.)

16033 **(SCPRI-RM—7-1987) Monthly results of measurements, July 1987.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Aug 1987. 54p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751857/JAW.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface waters, underground water, drinking water, sewage water, food chain (milk, vegetables, fishes), sea water around nuclear plant sites and other sites, sediments. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobyl accident.

16034 **Atmospheric radioactivity and variations in the solar neutrino flux.** Zerda Lerner, A. de la; O'Brien, K. (Department of Energy, New York, USA. Environmental Measurements Lab.). *Nature (London);* **330**: No. 6146, 353-354(26 Nov 1987).

The authors present a calculation of the inventory of positron emitters in the Earth's atmosphere that results from hadronic cascades initiated by galactic cosmic rays, and the variation of this source of low-energy neutrinos with the 11-year solar cycle. The results rule out the possibility that cosmogenic neutrino emitters are responsible for an apparent solar-cycle dependence, as reported in a recent solar neutrino experiment. As atmospheric secondary-particle decay was previously eliminated as a significant neutrino source, any such variations, if corroborated over the next sunspot cycle, would appear to be caused by phenomena outside the Earth's atmosphere, most likely in the Sun itself.

16035 **Tritium analysis by resonance ionization.** Keffer, C.E.; Cochran, D.A.; Whitaker, T.J.; Reeder, P.L. *Transactions of the American Nuclear Society;* **52**: 359(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Instrumentation for near-real-time analysis of tritium is being developed for ambient air sampling. The technique involves separation of molecular hydrogen gas from air, dissociation of the molecules, resonance ionization of the resulting hydrogen atoms, and detection by mass spectrometry. The goal is to provide a rapid analysis of extremely small concentrations and to have complete discrimination between hydrogen, deuterium, and tritium isotopes over a very wide range of relative abundances. Applications include environmental monitoring of ambient air around reactors and other nuclear facilities.

16036 **Parametric analysis evaluating mathematical models used to assess radiological releases from a hypothetical nonpower reactor.** Sanchez-Pope, A.E.; Scoggins, W.A.; Zerwekh, W.D. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 367(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The HAVOC computer code was developed to model radiological releases from nonpower reactors following a hypothetical accident. The code contains four dispersion models, seven dispersion sets, and the capability to correct for decay, plume rise, and depletion. For this study, we used the code to calculate the thyroid and whole-body doses to individuals exposed under varying conditions. The individuals exposed were located both within the building wake cavity and beyond it. To evaluate the sensitivity of the models to various physical parameters (that is, weather stability, dispersions, stack velocity, radius of stack, distance of receptor, and wind speed), a parametric study of these parameters was performed.

16037 **Radioactivity in the environment: Sources, distribution and surveillance.** Kathren, R.L. New York, NY; Gordon and Breach Science Publishers Inc. (1984). 412p. Gordon and Breach Science Publishers Inc., P.O. Box 786, Cooper Station, New York, NY 10276.

Radioactivity in the Environment provides the background and techniques necessary for understanding and monitoring today's radiological environment. It presents an overview of the entire field, including both natural and manmade sources of radiation, radiation distribution, and methods of environmental dose assessment, surveillance and measurement.

5004 Thermal Effluents Monitoring And Transport

16038 **(DFVLR-FB—87-30) Numerical simulation of the thermally generated mountain-foreland circulation.** Somieski, F. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.); Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Oberpfaffenhofen (Germany, F.R.). Inst. fuer Physik der Atmosphaere). 1987. 189p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751694/JAW.

A hydrostatic mesoscale model is used for numerical simulation of the thermally generated mountain-foreland circulation. For an idealized large mountain valley especially the influence of different mountain shapes and various surface properties is investigated

with respect to the energy budget and the mountain and valley winds. In this way the importance of the mountain structure, the mean orography height of the valley catchment area, the volume effect, of advection, surface evaporation, thermal soil parameters, and snow cover is shown. With 55 figs., 14 tabs., 114 refs..

16039 (NP—8751663, pp 43-49) **Semi-analytical solution of the heat conduction equation in different boundary conditions.** Hennemuth, B.; Oberle, H.J. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

The process for solving initial boundary value problems for the heat conduction equation is based on the explicit calculation of the Fourier development with homogeneous boundary conditions. The temperature distribution in the atmospheric boundary layer over the sea with a wind from the land and the temperature distribution in the ground to a depth of 1 m at a given heat flow through the surface are calculated as examples.

16040 (NP—8751663, pp 121-128) **Atmospheric aerosol components: Characteristics and climatic relevance.** D'Almeida, G.A. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

Atmospheric aerosols consist of components of different origins. Their climatic importance is described from the point of view of these components. The optical properties are represented using the example of the two most important natural type of aerosols. The maritime aerosol shows slight variability, scatters the incoming radiation completely over a large part of the solar spectrum, while the mineral aerosol shows the highest variability and absorbs most in the range of the atmospheric window.

5006 Regulations

REFER ALSO TO CITATION(S) 14727, 14728, 14729, 15985

16041 (CONF-8703206—, pp 37-60) **Importance of the VDI Code of Practice for working practice and for the professional activities of engineers.** Johann, H.P. (Mannesmann A.G., Duesseldorf, Germany, F.R. Abt. Umweltschutz). 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751688/JAW.

From 30. anniversary of the VDI Commission on air pollution prevention; Duesseldorf, F.R. Germany (17 Mar 1987).

Schriftenreihe der VDI-Kommission Reinhaltung der Luft.; v. 6.

The lecture gives an idea of the importance of the regulations in general and of the VDI regulations for working practice in particular. The subjects of environmental protection, such as keeping the air clean and reducing noise, are particularly stressed.

16042 (CONF-8703206—, pp 61-88) **Aims, importance and measurement of maximum immission concentration (MIC values) of the VDI Clean Air Commission.** Stratmann, H. (Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen, Germany, F.R.). 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751688/JAW.

From 30. anniversary of the VDI Commission on air pollution prevention; Duesseldorf, F.R. Germany (17 Mar 1987).

Schriftenreihe der VDI-Kommission Reinhaltung der Luft.; v. 6.

MIC values are the essential foundation of the limiting value concept successfully followed so far by the State for immission protection in the field of health protection. One must therefore check whether new requirements in connection with the introduction of prophylactic measures have adverse effects on the MIC values or even throw doubt on them in connection with the requirement for the 'zero effect solutions'. The answer to this challenge is given by a representation of the scientific possibilities for opening up new methods, via dose-effect relationships, for limiting reversible and irreversible damaging effects for the human toxic and the phytotoxic areas. Irritation threshold functions are introduced, which take the place of the MIC values, and can give the limiting value concept of the law new support. Possible solutions for measuring the combined effects of highly toxic materials are also discussed.

16043 (CONF-8703206—, pp 89-109) **Balancing criteria in determining the state of technology and their assessment.** Thoenes, H.W. (Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen, Germany, F.R.). 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751688/JAW.

From 30. anniversary of the VDI Commission on air pollution prevention; Duesseldorf, F.R. Germany (17 Mar 1987).

Schriftenreihe der VDI-Kommission Reinhaltung der Luft.; v. 6.

Secure practical suitability cannot any longer be confirmed by the operation of pilot plants, particularly for new types of processes and devices. Experience shows that a prototype plant gives appropriate and certain knowledge of the state of development. The VDI Clean Air Commission can give help in making decisions in representing the state of technology in the VDI Code of Practice in the field of emission by including the proposed balancing criteria for assessing advanced processes and devices.

16044 (KFK-PEF—27) **Cost-effectiveness-analysis of strategies to reduce SO/sub 2/- and NO/sub x/-emissions in urban areas.** Voss, A.; Friedrich, R.; Boysen, B.; Mattis, M.; Bach, H.; Claus, G.; Baessler, R.; Essers, U.; Greiner, R.; Besser, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre; Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Sep 1987. 291p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751701/JAW.

On the example of the city of Stuttgart costs and effectiveness of several methods to reduce the SO/sub 2/- and NO/sub x/-emissions for urban areas are investigated. Present and future SO/sub 2/- and NO/sub x/-emissions are calculated split up into four sectors: Power plants, plants $\geq$ 1 MW/sub th/, plants $<$ 1 MW/sub th/ and transportation. Furthermore the calculations give the results for each of Stuttgart's city-districts separately. Subsequently measures for the reduction of SO/sub 2/- and NO/sub x/-emissions in all sectors are identified and analyzed. To determine the costs and the reduction of the emissions the application of abatement-methods is simulated. Suggestions for an environmental policy as efficient as possible are deduced from the result of these calculations. With 89 figs., 71 refs..

16045 (NP—8751667) **Evaluation of the implementation of air pollution control measures on production site level when bubble policy is applied.** Rentz, O.; Ballreich, K.L.; Haasis, H.D.; Heer, W. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Industriebetriebslehre und Industrielle Produktion; Umweltbundesamt, Berlin (Germany, F.R.)). Jul 1985. 398p. (In German). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88751667/JAW.

Based on empiric data and on real practical case studies in the sectors of energy supply, oil refineries, metallurgical and chemical industries, the consequences of an application of the Bubble policy are evaluated on a production site level. The air pollutants SO/sub 2/, NO/sub x/, fumes and hydrocarbons are included. The bubble theory is exactly defined, cost reduction potentials are given and calculated under typical application in the Federal Republic of Germany. Criterions for the bubble development such as definition of production units, dynamic changes of standards, retrofitting problems, the admitted emitted mass flow etc. are discussed. On a practical level bubbles are realized and analyzed. The results of the calculations are reported. It can be pointed out that significant cost reductions can be expected if, on one hand, the required emission reduction level for a given pollutant is low and if, on the other

hand, up to the considered date only few emission control measures have been realized. With 139 refs., 54 tabs., 41 figs..

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 15975, 15976, 16064

16046 **(DOE/ER/60264—T1) Physiological and ecological implications of coupled heat- and water-transport mechanisms of endotherms and vegetation: Progress report for period 1 July 1986-31 January 1987.** Porter, W.P.; Stewart, W.E. (Wisconsin Univ., Madison (USA)). Feb 1987. Contract FG02-84ER60264. 11p. NTIS, PC A03. Order Number DE88004170/JAW.

Current quantitative general heat- and mass-transfer model for porous insulation (FUR) of endotherms is described along with the performance of the model in predicting the heat-generation requirements and water-loss rates for different insulations under conditions measured in the laboratory and in the field. The mechanistic model for endotherms will ultimately provide an enhanced means for generating and testing ecological hypotheses, such as environmental effects on herbivory rates, growth and reproduction rates, survival probabilities and population dynamics. The responses of endotherms to environmental contaminants could also be assessed. We have linked individual physical and physiological properties directly to population dynamics models. We have also begun to incorporate stochastic processes into the models to deal with uncertainty in environments and animal physiological properties. 8 refs., 1 fig.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 14095, 14392, 14393, 15416, 16022, 16065, 16070, 16076, 16078, 16242, 16257

16047 **(CONF-870802—38) A speciation method for partitioning mononuclear and polynuclear aluminum using ferron.** Jardine, P.M.; Zelazny, L.W. (Oak Ridge National Lab., TN (USA); Virginia Polytechnic Inst., Blacksburg (USA)). 1987. Contract AC05-84OR21400. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003882/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

The kinetic reactions of ferron with unneutralized and partially neutralized Al solutions in the presence of various inorganic and organic anions were investigated with the intent of distinguishing mononuclear and polynuclear Al. Mononuclear Al solutions containing ClO_4^-, Cl^-, NO_3^-, SO_4^{2-}, $H_2PO_4^-$, and F^- with anion to Al molar ratios of 13, 21, 15, 5, 0.75, and 0.08, respectively, expressed similar reactions with ferron which conformed to a single second-order reaction. Mononuclear Al solutions containing malate, glutarate, succinate, salicylate, formate, malonate, and fulvate with ligand/Al molar ratios ranging from 0.4 to 7.5, also reacted rapidly with ferron and were modeled using a single second-order equation. Similarily, mononuclear Al solutions containing citrate, tartarate, and oxalate with ligand/Al molar ratios $\leq$ 0.13, 0.08, and 0.38, respectively, also were modeled using a single second-order expression. Ferron interactions with partially neutralized Al-anion solutions were described by two simultaneous second-order reactions which provided the rate of Al polymer interactions with ferron, k/sub b/, and the mole fraction of mononuclear Al species present, f/sub a/. Model-fitted f/sub a/'s are based on the differential kinetic reactions of ferron with Al, thus arbitrary separation times for determining mononuclear and polynuclear Al are avoided. Increasing concentrations of $H_2PO_4^-$, F^-, citrate, tartarate, and oxalate which cause the ligand/Al molar ratios to exceed the critical values of 0.75, 0.08, 0.13, 0.08, and 0.38, respectively, form complexes with Al that are not easily degraded by ferron thus limiting the credibility of accurate distinction between monomeric and polymeric Al. 11 figs., 5 tabs.

16048 **(Juel-Spez—396) Status seminar - soil quality and water balance (soil research).** Boller, F.; Scheele, B. (eds.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Biologie, Oekologie, Energie). Apr 1987. 208p. (In German). (CONF-8612120—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88751702/JAW.

From 1. status seminar on the BMFT project soil quality and water balance; Bonn, F.R. Germany (4 Dec 1986).

Since May 1985 the Federal Minister of Research and Technology has supported by a grant research activities dealing with soil quality and water balance (soil research). In December, 4 and 5, 1986 the Project Management for Ecological Research in the Nuclear Research Centre Juelich organized the first 'Statusseminar' (meeting) on the supported program. It was not intended to present results of some research projects, but to give a survey on the state of activities, to enhance exchange of information between different disciplines of research and to discover research deficiency. Members of the Project Management, scientific experts and scientists working on this program lectured on special problems. The seminar resulted in the description of still existing research needs.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 14210, 14211, 14212, 14213, 14214, 14229, 14235, 14236, 14260, 14261, 14279, 14280, 14281, 14282, 14283, 14284, 14293, 14294, 14295, 14299, 14300, 14301, 14302, 14320, 14321, 14337, 14635, 14637, 14688, 15409, 15416, 15543, 16025, 16033, 16037, 16082, 16083, 16203, 16220

16049 **(AERE-R—11996) Diffusion studies on evaporitic rocks, slates, cements and concretes.** Bradbury, M.H.; Green, A. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.). Jun 1986. 46p. H.M. Stationery Office, London, price Pound 5.00.

Diffusion parameters and permeabilities have been measured for a series of evaporitic rock types, to provide parameters for modelling migration rates of radionuclides in an underground radioactive waste repository. Also diffusion measurements are presented for slates obtained from three different regions in the United Kingdom, because slate formations are of interest as a host rock for medium-level radioactive waste disposal. Mass transport properties of a range of cements and concretes relevant to land and deep sea disposal were determined.

16050 **(AERE-R—12321) Some notes on experiments measuring diffusion of sorbed nuclides through porous media.** Lever, D.A. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Nov 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750942/JAW.

Various experimental techniques for measuring the important parameters governing diffusion of sorbed nuclides through water-saturated porous media are described, and the particular parameters obtained from each technique are discussed. Recent experiments in which diffusive transport takes place more rapidly than expected are reviewed. The author recommends that through-transport diffusion experiments are the most satisfactory method of determining whether this arises from surface diffusion of sorbed nuclides.

16051 **(CEGB-TPRD/B—0735/R86) Field study of the uptake of ^{35}S and ^{14}C into crops characteristic of the UK diet.** Kluczewski, S.M.; Bell, J.N.B.; Nair, S. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Feb 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750869/JAW.

The uptake of ^{35}S and ^{14}C into crops characteristic of the UK diet was studied. Four common types of green vegetable, six common types of root vegetable and perennial ryegrass were grown in a garden plot in the environs of Hinkley Point Nuclear Power Station and the ^{35}S and ^{14}C contents of the crops were measured. Also measured were the corresponding air concentrations over the plot averaged over a range of time periods between sowing and harvesting. The results were analysed in terms of air to crop transfer factors for ^{35}S and ^{14}C and the implications of these for dose calculations were assessed for both collective dose and for

a hypothetical critical group consuming a range of foods produced in situ.

16052 **(CONF-830462—Vol.1) The transfer of radioactive materials in the terrestrial environment subsequent to an accidental release to atmosphere, Volume 1: Proceedings.** (Commission of the European Communities, Luxembourg. Directorate for Health and Safety; Commission of the European Communities, Brussels (Belgium)). Jul 1983. 435p. (In several languages). NTIS (US Sales Only), PC A19/MF A01. Order Number DE88900334/JAW.

From Seminar on the dynamics of the transfer to man of radioactive materials deposited subsequent to an accidental release to atmosphere; Dublin, Ireland (11 Apr 1983).

Individual papers are processed separately for the databases. (PSB)

16053 **(DOE/ER/60531—T1) Screening models to predict food-chain transfer of environmental toxicants: Progress report for the period April 1 to November 15, 1987.** Ward, G.M.; Johnson, J.E. (Colorado State Univ., Fort Collins (USA)). 1987. Contract FG02-87ER60531. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004082/JAW.

To date, two experiments with laying hens have been completed and two studies with milking goats will be concluded by the end of the project year. This study will elucidate transfer parameters using the goat and hen as screening models. There are strong arguments for use of the Transfer Coefficient (F/sub j/) parameter for transfer of certain environmental elements to animal food products. The Observed Ratio (OR) also has validity for certain element/carrier pairs. There are interesting species differences in both parameters and a general conclusion that the variability of experimental results could be reduced if more attention were given to chemical form, biological carrier, and experimental methodology. Animal experiments are designed to determine the influence of carrier elements upon the transfer of tracer elements to milk, eggs and meat. The biological transfer uncertainty will be determined by minimizing all variables other than carrier element and mass. 4 refs., 2 tabs.

16054 **(DOE/ER/60581—T1) Effects of vegetation on radon transport processes in soil: Performance report for the period March 15 through October 31, 1987.** Whicker, F.W.; Borak, T.B. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). 24 Nov 1987. Contract FG02-87ER60581. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004947/JAW.

The hypothesis that plant functions increase soil radon flow to the atmosphere, thus measurably reducing the flow into subsurface spaces, was addressed by constructing two virtually identical subterranean structures, one serving as a control (without surrounding vegetation) and the other serving as the treatment (surrounded by vegetation). The two structures will be thoroughly characterized before inducing treatment differences. Their relative radon concentrations and soil/basement/atmosphere gas pressure differentials and soil temperature/moisture profiles will be compared. The radon concentration responses to induced soil moisture changes will also be studied. Following such characterization, the experimental treatment structure will be surrounded by rapidly-growing, deep-rooted plants with a high evapotranspiration potential. Radon concentrations in each structure, as well as soil gas pressure differentials, soil water content, and soil temperatures will be monitored continuously. Seasonal and diurnal cycles in radon concentrations were studied with respect to the presence of vegetation and to soil and meteorological variables and changes in soil properties resulting from the presence of roots.

16055 **(EGG—10282-1137) An aerial radiological survey of the Perry Nuclear Power Plant and surrounding area, North Perry, Ohio: Date of survey: April 1987.** Fritzsche, A.E. (EG and G, Inc., Las Vegas, NV (USA). Remote Sensing Lab.). 1987. Contract AC08-83NV10282. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004343/JAW.

An aerial radiological survey was conducted over the Perry Nuclear Power Plant, North Perry, Ohio. The purpose of the 234-square-kilometer (91-square-mile) survey was to document the terrestrial gamma environment of the plant and surrounding area. An exposure rate contour map at 1 meter above ground level was constructed from the gamma data and overlaid on an aerial photograph and map of the area. Exposure rates increased from 0 microroentgens per hour (μR/h) over Lake Erie to 9 μR/h as the distance from Lake Erie increased. Only one anomalous area appears on the map, which is due to an excess of Bi-214 in a landfill area. Ground-based exposure rate measurements and soil samples were obtained to support the aerial data. Oblique aerial photographs of the plant were also acquired during the survey. 6 refs., 6 figs., 1 tab.

16056 **(ENEA-RT-COMB—87-1) Post Chernobyl-4: radionuclides measurement in Saluggia (Vercelli) ground.** Giacomelli, R.; Spezzano, P.; Nocente, M.; Dattrino, A.; Massironi, L.; Ornaghi, A.; Silvestri, N.; Porzio, L.; Olivetti, R. (ENEA, Rome (Italy)). Mar 1987. 16 p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751901/JAW.

After a description of sampling and measurement methods, the values of soil concentration for gamma emitters measured in Saluggia from April 10 to July 24, 1986 are here reported. For some samples, 89Sr, 90Sr, 238Pu and 239-240Pu were also measured.

16057 **(ENEA-RT-COMB—87-5) Post Chernobyl-4: exposure intensity measurement in Saluggia (Vercelli).** (ENEA, Rome (Italy)). Jun 1987. 12 p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751902/JAW.

After a description of the measurement methods, the values of gamma exposure rates measured in Saluggia from May 5 to May 30, 1986 are reported.

16058 **(ENEA-RT-PAS—87-8) Environmental study of fallout plutonium in soils from the Piemonte region (North-West Italy).** Cigna, A.A.; Cigna Rossi, L.; Sgorbini, S.; Zurlini, G. (ENEA, Rome (Italy)). Jul 1987. 15 p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751910/JAW.

Estratto da: J. Environ. Radioactivity, 5 (1987), p.71-81.

The distribution of 238Pu and 239 + 240Pu on the surface of the Piemonte region, was measured and the main factors influencing Pu concentrations investigated. Rainfall, altitude and the concentration of organic matter play an important role, while other soil parameters (pedology, lithology and geomorphology) are of lesser significance. Contour maps of the surface soil concentrations of 238Pu and 239 + 240Pu are reported.

5104 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 15961, 16095

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 13977, 14092, 14093, 16097

16059 **(EGG—10282-2182) Distribution of dens used by radiocollared San Joaquin kit fox on Naval Petroleum Reserve No. 1, Kern County, California, 1980-1987.** O'Farrell, T.P.; Tabor, S.P.; Kato, T.T. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Sep 1987. Contract AC08-83NV10282. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005078/JAW.

Locations of 945 dens used by radiocollared San Joaquin kit foxes (Vulpes macrotis mutica) on or adjacent to the US Department of Energy's Naval Petroleum Reserve No. 1 (NPR-1) in western Kern County, California between 1980-1987 were recorded on maps and stored within a computer-compatible data base. Most (516 of 887) typical subterranean dens of this endangered species were found in undeveloped portions of 65 sections, but most (41 of 58) atypical dens (dens in man-made structures) were found in developed portions of 26 sections. Program managers can plan construction, maintenance, and operational activities on NPR-1 in ways that avoid potential conflicts with the conservation of kit fox dens by

using the section maps provided in this report or by accessing the computerized data base through the Endangered Species Contractor, EG & G Energy Measurements, Inc. 20 refs., 3 figs, 1 tab.

16060 **(EGG—10282-2184) Movements and home range of San Joaquin kit foxes on the Naval Petroleum Reserves, Kern County, California.** Zoellick, B.W.; O'Farrell, T.P.; Kato, T.T. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Sep 1987. Contract AC08-83NV10282. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005188/JAW.

Movements and home range use of San Joaquin kit foxes (Vulpes macrotis mutica) were studied on and adjacent to the Naval Petroleum Reserves (NPR-1 and NPR-2), Kern County, California, between June 1984 and September 1985. Foxes were studied in an undeveloped area of Buena Vista Valley centered on the border between the Reserves, and in an area of intensive petroleum development in NPR-2 adjacent to the city of Taft. Distances moved nightly did not differ between sexes or between level of petroleum development. Nightly movements averaged 9.4 miles in length during the breeding season, and were significantly longer than the average nightly movements for the pup-rearing (6.4 miles) and pup-dispersal (6.5 miles) seasons. Convex polygon home ranges averaged 1144 acres in size and did not differ between sexes or level of petroleum development. Home ranges of paired males and females overlapped an average of 78%. Home ranges of nonpaired males and females, adjacent males, and adjacent females overlapped an average of 31 to 48%. Although kit foxes were not strongly territorial, home range overlap of paired males and females was significantly greater than that of either nonpaired males and females and males with adjacent home ranges. Home range overlap did not differ between foxes inhabiting developed and undeveloped areas. 42 refs., 10 figs., 9 tabs.

16061 **(ORNL/NERP—1) Oak Ridge National Environmental Research Park, Department of Energy Program Plan.** Parr, P.D. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004768/JAW.

The Department of Energy's Office of Health and Environmental Research (DOE-OHER) is developing an overall research plan for the National Environmental Research Parks (NERPs) program, which it administers nationally. Each NERP will develop its own program plan, following an outline developed by NERP managers, DOE Operations Offices, and DOE-OHER. The Oak Ridge NERP program plan includes an introduction to the concept and mission of a NERP; the philosophy, program integration, and administration of the Oak Ridge NERP; specific goals and objectives; progress to date; and, future issues on a national and local level. 5 refs., 4 figs., 2 tabs.

5106 Regulations

REFER ALSO TO CITATION(S) 14728, 14729

16062 **(PB—88-113691/XAB) Remedial-Action Costing procedures manual. Final report, January 1985-September 1986.** Burgher, B.; Culpepper, M.; Zieger, W. (JRB Associates, Inc., McLean, VA (USA)). Oct 1987. 68p. NTIS, PC A04/MF A01.

This manual provides specific procedures for the cost estimating and economic analysis steps required for preparing engineering cost estimates for selecting remedial-action alternatives in response to the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (40 CFR 300). The manual is designed to be used in conjunction with EPA's manual entitled Guidance on Feasibility Studies Under CERCLA (1985). The audience for the manual includes EPA Regional Project Officers, remedial investigation/feasibility study contractors, and state and local remedial action personnel and other Federal agencies. Detailed procedures are provided for generating estimated capital and annual operating costs, calculating annual costs and present worth for each remedial-action alternative, and performing sensitivity analyses of the cost estimates to determine the impact of changes to various cost input parameters. Worksheets are provided to assist the user in developing the feasibility cost analyses. An example cost analysis is provided to illustrate these procedures.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 14094, 16287

16063 **(NIVA-O—81036) Predicting acidification of North American lakes.** Wright, R.F. (Norsk Inst. for Vannforskning, Oslo). May 1983. 166p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751190/JAW.

An empirical model for lake acidification developed in Norway also satisfactorily accounts for observed water chemistry in oligotrophic clearwater, softwater lakes elsewhere in Europe and in North America. This model can be used for prediction of lake acidity in response to future changes in loadings of strong acids. The model takes into account both changes in base cation concentrations and changes in alkalinity due to acid inputs. 40 refs., 34 figs., 13 tabs.

16064 **(SI-R—850137-1) Critique of models for freshwater and soil acidification.** Reuss, J.O.; Christophersen, N.; Seip, H.M. (Senter for Industriforskning, Oslo (Norway)). Jul 1986. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751202/JAW.

Four types of models quantifying effects of acid deposition on fresh water are reviewed. Emphasis is on an assessment of critical assumptions. The models range from simple to very complex and from empirical to highly process oriented. The various types have all proven useful, and there has been a significant convergence concerning key processes. 62 refs., 1 fig.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 13979, 14084, 14084, 14095, 14391, 14889, 15416, 15532, 16022, 16048, 16063, 16242, 16251, 16256, 16286

16065 **(AD-A—185615/2/XAB) Evaluation of the MULTISED (Multiple Watershed Storm Water and Sediment Runoff Simulation) simulation model to predict sediment yield. Final report.** Wenzel, H.G.; Melching, C.S. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Sep 1987. 89p. (CERL-TR-N—87/27). NTIS, PC A05/MF A01.

The MULTISED (Multiple Watershed Storm Water and Sediment Runoff Simulation) model was evaluated as a tool that will help Army land managers assess the environmental conditions of troop training areas to determine the need for remedial action. The sensitivity of model parameters was explored using two watersheds. Guidelines for calibrating the model were developed, based on a best-fit criterion between measured and computed runoff hydrographs. The results support MULTISED application and indicate how improvements to the model can be made.

16066 **(DOE/ID—22074) Purgeable organic compounds in ground water at the Idaho National Engineering Laboratory, Idaho.** Mann, L.J.; Knobel, L.L. (Geological Survey, Idaho Falls, ID (USA)). Dec 1987. 27p. (USGS-OFR—87-766). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005274/JAW.

Reconnaissance-level sampling for purgeable organic compounds in ground water was conducted at the Idaho National Engineering Laboratory during June to November 1987. Water samples from 81 wells that tap the Snake River Plain aquifer and that are equipped with dedicated pumps were collected and analyzed for 36 purgeable organic compounds. Twelve compounds were detected in the samples, including carbon tetrachloride; 1,1,1-trichloroethane; trichloroethylene; tetrachloroethylene; and toluene. Except for one sample, the maximum concentration of purgeable organic com-

pounds was 7.7 μg/L (micrograms per liter). One injection well used to dispose of waste water prior to 1973, however, yielded water that contained 35,000 μg/L of trichloroethylene and 22,000 μg/L of 1,2-trans-dichloroethylene. A water sample from a discontinuous perched-water zone at the Radioactive Waste Management Complex was collected using a thief sampler. The water contained 1200 μg/L of carbon tetrachloride, 860 μg/L of trichloroethylene, and 650 μg/L of chloroform. The ground-water samples were analyzed at the US Geological Survey's National Water Quality Laboratory in Arvada, Colorado. In addition, 39 duplicate samples were analyzed at the Environmental Chemistry Laboratory operated by the US Department of Energy's contractor, EG & G Idaho, Inc. Methods used to collect the water samples and quality assurance instituted for the sampling program are described in detail.

16067 **(GKSS—87/E/9) Distribution of chlorinated hydrocarbons in sediment and seston of the river Elbe.** Sturm, R.; Knauth, H.D.; Reinhardt, K.H.; Gandrass, J. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 18p. (In German). Special print from Vom Wasser (1986) v. 67 p. 23-38.

During the period 1983-1985 sediment samples of the River Elbe (and for comparison from the River Weser, North Sea, Baltic Sea) were taken from the sediment surface and from levels up to one meter below. Seston was collected from depths one meter below the water surface by continuous-flow centrifugation. Samples were analysed qualitatively and quantitatively for the concentrations of non-volatile chlorinated hydrocarbons. Sediment samples from different areas of the River Elbe show an Elbe-typical distribution pattern of chlorinated hydrocarbons compared to sediments from other waters of the Federal Republic of Germany, characterized by a dominating hexachlorobenzene peak and a marked octachlorostyrene peak in the capillary gaschromatogram. Concentrations of organochlorines in sediments from different parts of the River Elbe vary considerably. Correlations with the content of organic carbon can be made. Areas with a high sedimentation rate have twice as much chlorinated hydrocarbons in the first 4 to 5 cm of the sediment surface than in the layers below. In contrast to solutions with large amounts of hexachlorocyclohexanes, seston has a distribution pattern of organochlorines similar to sediment, although concentrations in general are much higher.

16068 **(NIVA-O—82014) Data recording manual on pollution effluents in watercourses and fiords.** Venneroed, K. (Norsk Inst. for Vannforskning, Oslo). Sep 1984. 49p. (In Norwegian). (NIVA-F—82436). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751189/JAW.

The manual presents calculation and evaluation methods for quantifying the amounts of pollution effluents such as phosphorus, nitrogen, and organic materials in watercourses and fiords. The methods are used to determine the quantity of effluents to particular recipients in order to find the main pollution source and not to determine the quantity of effluents as a whole. 4 drawings, 12 tables, 23 references.

16069 **(PB—88-111901/XAB) EPA (Environmental Protection Agency) activities related to sources of ground-water contamination.** Black-Coleman, W. (Booz-Allen and Hamilton, Inc., New York (USA)). Feb 1987. 149p. NTIS, PC A07/MF A01.

The report contains a listing of EPA programs and activities, as of October 1986, that address 33 sources of potential ground-water contamination. The information on each activity is presented in a matrix format that is organized by type of contamination source. The following information is presented for each program and activity listed: title, lead office, contact person, type of activity (study, regulation, guidance, strategy, etc.) status, and a summary of the activity. The 33 sources of ground-water contamination are discussed in the 1984 EPA Office of Technology report: Protecting the Nations Ground Water from Contamination.

16070 **(PB—88-120803/XAB) Final environmental impact statement of the proposed coastal-management program for the state of Florida.** (Florida State Dept. of Environmental Regulation, Tallahassee (USA)). Aug 1981. 641p. NTIS, PC A99/MF A01.

The State of Florida has submitted its Coastal Management Program to the Office of Coastal Zone Management for approval. Approval would allow program administrative grants to be awarded to the state, and would require that Federal actions be consistent with the program. The document includes a copy of the Program which is a comprehensive management program for coastal land- and water-use activities. The FCMP consists of numerous policies on diverse management issues that are administered under various state laws, and is the culmination of several years of program development.

16071 **(PB—88-122585/XAB) Factors affecting the mobilization, transport, and bioavailability of mercury in reservoirs of the Upper Missouri River Basin. Technical report.** Phillips, G.R.; Medvick, P.A.; Skaar, D.R.; Knight, D.E. (Montana Cooperative Fishery Research Unit, Bozeman (USA)). 1987. 71p. (LCCCN—86-607921). NTIS, PC A04/MF A01.

Library of Congress catalog card no. 86-607921.

Factors controlling the mobilization, transport, and bioavailability of mercury in relation to coal mining and other mercury sources were studied in reservoirs of the Upper Missouri River Basin. The authors assessed mercury and selenium contamination of fishes and sediments in 10 reservoirs, estimated mercury fluxes in Tongue River Reservoir, determined dietary accumulation of methylmercury by fish. Detailed limnological studies were conducted in Nelson, Cookson, and Tongue River reservoirs.

16072 **(PB—88-124094/XAB) Biological treatment of toxics in waste water: the problems and opportunities.** Bishop, D.F.; Jaworski, N.A. (Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab.). Oct 1987. 32p. (EPA—600/D-87/326). NTIS, PC A03/MF A01.

EPA research on toxics control in waste-water treatment involves three approaches: (1) specific toxics treatability to determine the respective contribution of the three removal mechanisms in conventional wastewater treatment; (2) toxicity detection and reduction in treatment and pretreatment; and (3) innovative concepts to enhance control of toxics in biological treatment. The goal of the treatability research is to develop predictive procedures to estimate the fate of specific toxics in conventional wastewater treatment. Progress in developing the data on the removal mechanisms of partitioning, volatilization, and biodegradation is described. Toxicity reduction evaluation (TRE) studies are being used to isolate and trace the causes of toxicity pass-through in treatment, to identify the specific toxics, and to evaluate treatment and pretreatment approaches to reduce toxicity pass-through. Innovative concepts to enhance toxic control include control of the toxic discharge rates into treatment; use of additives such as clays, binding proteins, carbons, enzymes, etc.; use of anaerobic-aerobic treatment combinations, use of bioengineered organisms, and the use of special reactors and operational approaches at central treatment plants to improve toxics removals.

16073 **(PB—88-124102/XAB) Great Lakes ecosystem - modeling of the fate of PCBs (polychlorinated biphenyls).** Thomann, R.V.; Connolly, J.P.; Thomas, N.A. (Manhattan Coll., Bronx, NY (USA). Dept. of Environmental Engineering). Oct 1987. 55p. NTIS, PC A04/MF A01.

The report defines the polychlorinated biphenyl (PCB) problem in the Great Lakes, describes how they got there, describes models of: (1) physical/chemical fate generally; and, (2) specifically, fate of PCBs in aquatic ecosystems. Theory, data and model results are given. Also addressed in the paper are the effect of solids dependent PCB partitioning and sediment diffusion on PCBs and a description of human exposure to PCBs through consumption of fish contaminated with PCBs.

16074 **(PB—88-124342/XAB) Literature review on toxic organic compounds in wastewater and sludge: their origin, health effects, removal, and breakdown. Special report.** Kitshoff, A.M. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Water Research). 1985. 50p. (CSIR-SR-WAT—68). NTIS, PC E05/MF E05.

North American Continent sales only.

Contents include: origin and occurrence of toxic organic compounds in sewage and waste water; characteristics of toxic organic compounds; health aspects; standard/permissible values for toxic organic compounds; distribution; degradation; removal of toxic organic compounds from waste water, sludge, and soil; analytical methods and procedures.

16075 **(PB—88-124995/XAB) Statewide survey of aquatic ecosystem chemistry, 1985. Final report.** McCleneghan, K.; Nelson, J.L.; King, J.T.; Baumgartner, S.J. (California State Dept. of Fish and Game, Rancho Cordova (USA). Fish and Wildlife Water Pollution Control Lab.). Dec 1985. 69p. (LAB—85-5). NTIS, PC A04/MF A01.

During 1985, the water quality of 50 California lakes and streams was examined on two occasions, once during the period of spring run-off and again during the fall dry period. Parameters measured included pH, alkalinity, hardness, conductivity, temperature major cations (calcium, magnesium, sodium, and potassium), major anions (nitrate, sulfate, chloride and phosphate), as well as total and dissolved concentrations of the trace elements aluminum, iron, manganese, molybdenum, and total concentrations of copper, selenium, and zinc. These characteristics identify the sampled waters as sensitive to the effects of acid deposition and susceptible to acidification.

16076 **(PB—88-125430/XAB) Role of acute-toxicity bioassays in the remedial action process at hazardous-waste sites.** Athey, L.A.; Thomas, J.M.; Skalski, J.R.; Miller, W.E. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Aug 1987. 119p. (EPA—600/8-87/044). NTIS, PC A06/MF A01.

This document is written to aid in making decisions regarding the use of standardized aquatic and terrestrial acute bioassays at hazardous-chemical waste sites. Other types of bioassays, including those for use with receiving waters and in-situ testing, are not discussed. The use of acute bioassays at hazardous-chemical sites is explained and illustrated for use in the remedial-action process. Step-by-step guidelines are presented whereby decisions can be made concerning the design of site-specific bioassay studies.

16077 **(PB—88-125703/XAB) Toxicity Reduction Evaluations in municipal wastewater-treatment plants.** Bishop, D.F. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Oct 1987. 31p. (EPA—600/D-87/320). NTIS, PC A03/MF A01.

Early work evaluating toxicity reduction in municipal treatment plants revealed substantive ecosystem toxicity and Ames mutagenicity in plant effluents. The ecosystem toxicity in one plant effluent, where the plant flow contributed a substantial fraction of the stream flow, produced significant damage to the stream ecosystem. The evolving management method to control toxics and toxicity in wastewater treatment is called a Toxicity Reduction Evaluation (TRE). The TRE involves four major elements: evaluating the causes of toxicity pass through at treatment plants; characterizing and identifying the components of toxicity; tracing toxicity to its sources; and evaluating treatment alternatives for controlling toxicity. Progress on municipal case history TRE studies described here indicate probable technical success in developing the TRE method for management ecosystem of toxicity in municipal wastewater treatment. While the relationship between the Ames mutagenicity and health effects risk has not been established, the relatively high levels of Ames mutagenicity in some municipal wastewaters suggest that health-effects toxicity will be important in future TRE methods.

16078 **(PB—88-143896/XAB) Technical Resource Document: treatment technologies for metal/cyanide-containing wastes. Volume 3. Final report, January-August 1987.** Palmer, S.A.K.; Breton, M.A.; Nunno, T.J.; Sullivan, D.M.; Surprenant, N.F. (Alliance Technologies Corp., Bedford, MA (USA)). Dec 1987. 749p. NTIS, PC A99/MF E04.

See also Volume 1, PB—88-131271, and Volume 2, PB—88-131289.

The Technical Resource Document provides information that can be used by environmental regulatory agencies and others as a source of technical information for waste-management options for hazardous liquid wastes containing heavy metals and/or cyanide compounds. These options include waste minimization, recycling, and treatment of waste streams. Emphasis was placed on the collection and interpretation of performance data for proven technologies. These include: Metals: precipitation, coagulation/flocculation, chemical reduction, membrane separation technologies, activated carbon adsorption, ion exchange, electrolytic recovery, thermal recovery; Cyanides: alkaline chlorination, ozonation, biological treatment, thermal destruction. These, and other potentially viable technologies, are described in terms of their actual performance in removing constituents of concern, their associated process residuals and emissions, and those restrictive waste characteristics that impact their ability to effectively treat the metal/cyanide wastes under consideration.

16079 **(PB—88-854492/XAB) Air ventilation and filtration. January 1970-December 1987 (citations from the NTIS data base). Report for January 1970-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 179p. NTIS PC N01/MF N01.

Supersedes PB—86-867785.

This bibliography contains citations concerning the removal of indoor particulate matter and the control of toxic vapors in industry, residential buildings, office buildings, and mining operations. Development and testing of devices to meet federal clean-air regulations are presented. Ventilation standards, and site-specific industrial surveys are presented. (This updated bibliography contains 350 citations, 59 of which are new entries to the previous edition.)

16080 **(UCRL—97737) Quality control experiments on organics in ground water at the Lawrence Livermore National Laboratory, Livermore, California.** McConachie, W.A.; Homan, D.N.; Rice, D.W. Jr. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 6p. (CONF-880143—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005226/JAW.

From International symposium on trace analysis in environmental samples and standard reference materials; Honolulu, HI, USA (6 Jan 1988).

Several quality control experiments were performed to evaluate some of the sources of variability in the chemical analysis of volatile organic compounds (VOCs) in ground water beneath the Lawrence Livermore National Laboratory (LLNL) site and nearby. We make some general observations on the sources of error and uncertainty in ground water investigations of this kind. Our ground water sampling network includes 200 wells completed in various water bearing zones beneath LLNL and adjacent land. Monitor wells are sampled quarterly, semiannually, or annually, depending on the well's position in the VOC plume. Two commercial California-certified laboratories analyze the samples for purgeable halocarbons and purgeable priority pollutant by EPA Methods 601 (8010) and 624 (8240), respectively. Up to 1300 ppB tetrachloroethylene (PCE) and 5700 ppB trichloroethylene (TCE) have been reported in the ground water from locations on the LLNL site where the US Navy had used these VOCs as solvents. The nearest, private drinking water well is about 0.5 km from the forward edge of the VOC plume, but not in its direct migration path; the nearest municipal well is 2.4 km from the forward edge.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 14224, 14225, 14235, 14239, 14240, 14241, 14244, 14245, 14247, 14253, 14281, 14303, 14315, 14637, 15416, 16033, 16037

16081 **(AERE-R—12399) Study of fish and shellfish radioactivity levels within the Cumbria Sea Fisheries District. (November 1984 - December 1985).** McKay, W.A.; Latawiec, D. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Nov 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750900/JAW.

Fish (cod, plaice, whiting and skate), crustacea (shrimp and Nephrops) and mollusc (winkle) samples have been collected from the Cumbria Sea Fisheries District between November 1984 and

end of December 1985. The samples have been counted for total beta activity, and a range of gamma and alpha emitters have been determined. The mean levels over the study period are, in general, of the same order as found by MAFF in 1984 in Cumbrian coastal waters and thus the dose from these nuclides on eating this seafood would be expected to be similar to 1984, within the ICRP principal dose limit of 1 mSv $year^{-1}$, assuming similar consumption rates. Most of the radiation dose to the critical group within the Cumbrian community comes through winkle consumption.

16082 **(CEA-DPS—85-06) Results of radioactivity measurements in France during 1983.** Calmet, D.; Daburon, M.L.; Patti, F.; Willemot, J.M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Sanitaire). Nov 1985. 42p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751360/JAW.

Various marine and continental sampling networks for the environmental monitoring of radioactivity of liquid waste discharges from French nuclear establishments have been set up by the Departement de Protection Sanitaire (DPS) since 1983. Measurements carried out on marine biological indicators: seaweeds, molluscs and fish caught all along the French shore, show that man-made radionuclide levels are locally higher both in the Channel near the release outlet of La Hague fuel reprocessing plant and in the influence area of the Rhone river waters in the Mediterranean sea. At the stations with the highest levels, the sanitary incidence of man-made radionuclides remains low, since it corresponds to a fraction in the range of 10/sup -5/ of the dose limit recommended by the International Commission on Radiological Protection. Continental measurements, especially those carried out on the crops from the agricultural area irrigated by the Compagnie Nationale d'Amenagement de la Region du Bas-Rhone et du Languedoc, corroborate the lack of transfers of radionuclides conveyed by the Rhone water to the agricultural produces of this region.

16083 **(CEA-DPS—86-09) Results of radioactivity measurements in French coastal waters during 1985.** Charmasson, S.; Calmet, D.; Daburon, M.L.; Jeanmaire, L.; Patti, F.; Willemot, J.M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Sanitaire). Dec 1986. 43p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751361/JAW.

Various sampling networks for the environmental monitoring of levels from radioactive waste releases from french nuclear plants have been set up by the Departement de Protection Sanitaire (DPS) since 1983. In 1985, various marine and freshwater biological indicators were collected regularly on the Channel, Atlantic and Mediterranean shores and at the level of the lower Rhone river. As in the previous years, the results showed the prevailing effects of the releases from the LA HAGUE reprocessing plant on the Channel and of the Rhone waters on the Mediterranean sea. Measurements at the level of the lower Rhone showed a clear labelling of the Rhone river waters by /sup 106/Ru. The monitoring of ruthenium levels in various biological indicators from the Mediterranean shore supplied a good representation of the marine areas affected by the Rhone river. At the stations with the highest levels, the sanitary consequence of man-made radionuclides remained low, representing a fraction in the range of 10/sup -5/ of the dose limit recommended by the International Commission on Radiological Protection.

16084 **(FLPU—85-7) In situ radionuclide migration studies in a shallow sand aquifer (Part 1).** Williams, G.M.; Alexander, L.S.; Hitchman, S.P.; Hooker, P.J.; Noy, D.J.; Ross, C.A.M.; Stuart, A.; West, J.M. (British Geological Survey, Keyworth. Fluid Processes Research Group; Department of the Environment, London (UK)). Jul 1985. 71p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750810/JAW.

As a result of a study of the geology of the British Nuclear Fuels premises at Drigg, Cumbria, the British Geological Survey identified a shallow glacial sand deposit approximately 1.5m thick, interbedded between two clay horizons. An array of boreholes has been contructed in this sand in order to study the migration of radionuclides introduced into the formation under controlled conditions of groundwater flow. Conservative tracers used in the field test include chloride (as NaCl, detected using a specific ion electrode) and iodine-131 (as NaI, detected radiometrically using a NaI (T1) crystal). Strontium-85 (as the chloride) has been used as a chemically reactive tracer in conjuction with ^{131}I. The principal research objectives of the programme are as follows:- (1) to undertake laboratory batch sorption experiments using core material from the field site in order to choose those nuclides of radiological interest that would migrate sufficiently quickly for their behaviour to be studied in a field experiment within a reasonable time period. (2) to identify and quantify the mechanisms for nuclide/sediment interaction by determination of the geochemical distribution of ^{85}Sr in contaminated cores using a sequential leaching procedure. (3) to obtain appropriate data on the hydraulic characteristics of the sand formation in order to construct a mathematical model to describe groundwater flow and reactive mass transport.

16085 **(FLPU—85-9) Study of natural and long term (10^3-10^4 yr) elemental migration in saturated clays and sediments. Part III.** Hooker, P.J.; West, J.M.; MacKenzie, A.B.; Scott, R.D.; Ridgway, I.M.; McKinley, I.G. (British Geological Survey, Keyworth. Fluid Processes Research Group; Department of the Environment, London (UK)). May 1985. 76p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750812/JAW.

Tracing element movements in two cores extracted from the deep bed of Loch Lomond was carried out using neutron activation analysis, XRF analysis, alpha and emission spectroscopy and fission track methods for dissolved uranium. It involved a detailed determination of solid and pure water phase concentration as a function of depth. A striking feature to emerge is the fixation of iodine, bromine and uranium and Ra226 in the marine layers. (U.K.).

16086 **(FLPU—85-10) In situ radionuclide migration studies in a shallow sand aquifer (Part 2 - appendices).** Williams, G.M.; Alexander, L.S.; Hitchman, S.P.; Hooker, P.J.; Noy, D.J.; Ross, C.A.M.; Stuart, A.; West, J.M. (British Geological Survey, Keyworth. Fluid Processes Research Group; Department of the Environment, London (UK)). Jul 1985. 168p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750811/JAW.

Part 2 of the in situ radionuclide migration studies in a shallow sand aquifer contains the following appendices:-1. Calculation of sorption parameters. 2. A low-cost manifold system for use with multi-level samplers. 3. Radioactivity curves for ^{131}I and ^{85}Sr. 4. Results of particle size analysis for sand aquifers. (U.K.).

16087 **(MAFF-AEMR—14) Radioactivity in surface and coastal waters of the British Isles, 1985.** Hunt, G.J. (Ministry of Agriculture, Fisheries and Food, Lowestoft (UK). Directorate of Fisheries Research). 1986. 48p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750879/JAW.

A summary of estimated public radiation exposures in 1985 resulting from liquid radioactive waste discharges from nuclear establishments monitored by the Directorate of Fisheries Research is presented in tabular form. The exposures are expressed in terms of the committed effective dose equivalents to, or as doses to skin of, members of the critical groups. Results for internal exposures incorporate the enhanced gut transfer factor for plutonium except where a more appropriate value is justified.

16088 **(MAFF-AEMR—15) Radioactivity in surface and coastal waters of the British Isles. Monitoring of fallout from the Chernobyl reactor accident.** Camplin, W.C.; Mitchell, N.T.; Leonard, D.R.P.; Jefferies, D.F. (Ministry of Agriculture, Fisheries and Food, Lowestoft (UK). Directorate of Fisheries Research). 1986. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750880/JAW.

The incremental contribution to the gamma dose rate in intertidal areas from Chernobyl was highest in areas of high deposition but this did not persist and an upper estimate to the dose by this route was about 0.025 mSv. Levels in low deposition areas were much less, so that overall no significant exposure occurred due to beach occupancy. The collective dose commitment from

Chernobyl fallout in marine pathways is tentatively estimated to be 30 man Sv. Almost all of this is due to consumption of sea fish and to the caesium radionuclides, but due to maximising assumptions in the calculation this is likely to be an overestimate. The collective dose commitment from freshwater fish is very difficult to assess with confidence but can be conservatively set at less than 1 man Sv at which level it is not significant.

16089 **(MAFF-AEMR—18) Radioactivity in surface and coastal waters of the British Isles, 1986.** Hunt, G.J. (Ministry of Agriculture, Fisheries and Food, Lowestoft (UK). Directorate of Fisheries Research). 1987. 62p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751833/JAW.

The report presents the results of the environmental monitoring programme carried out during 1986 by staff of the Directorate of Fisheries Research, Lowestoft, United Kingdom. The programme was set up to verify the satisfactory control of liquid radioactive waste discharges to the aquatic environment, and to ensure that the resulting public radiation exposure is within nationally-accepted limits. The environmental programme includes monitoring the environmental consequences of discharges of liquid radioactive wastes from four British Nuclear Fuels plc sites - at Sellafield, Springfield, Capenhurst and Chapelcross, and monitoring the environment impact of liquid radioactive discharges from Winfrith and Dounraey. Monitoring is also carried out near nuclear power stations operated by the electricity boards, near Naval establishments, near Amersham International plc, and the marine environment of the Channel Islands States. Results are also presented on the monitoring of the freshwater environment for radioactivity from the Chernobyl reactor accident. (U.K.).

16090 **(NAGRA-NTB—85-31) Model calculation of the groundwater flow at Oberbauenstock.** Grundfelt, B.; Lindbom, B.; Markstroem, A. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jun 1987. 78p. Nagra, CH-5401 Baden, Switzerland.

Model calculations of the groundwater flow at a potential site for an intermediate-level waste repository at Oberbauenstock in the Swiss Prealps have been performed. The study comprises two steps; modelling of the position of the groundwater table and modelling of the groundwater flow in the host rock. The calculations in the first case indicate that much of the sedimentary rock above the host rock is partially drained. The highest groundwater table obtained is about 100 m above the surface of the host rock. The second step shows that the flow through the host rock is directed downwards. Because the quantification of flow rate etc. is very sensitive to boundary conditions, it is deemed essential that a thorough understanding of the hydrology of the site be developed.

16091 **(NRPB-R—194) Preliminary comparison of models for the dispersion of radionuclides released into the deep ocean.** Mobbs, S.F.; Hill, M.D.; Koplik, C.; Demuth, C. (National Radiological Protection Board, Chilton (UK)). May 1986. 59p. H.M. Stationery Office, London, price Pound 5.00.

The modelling task group of the Nuclear Energy Agency's coordinated research and environmental surveillance programme (CRESP) on sea disposal devised a set of benchmark problems to test models of the dispersion of radionuclides following release into the deep ocean. The models were a 1-dimensional model, a 2.5-dimensional model, two 3-dimensional compartment models, a 3-dimensional diffusion model and a 3-dimensional general circulation model. Simple releases of ^{137}Cs, ^{14}C, ^{129}I, ^{230}Th and ^{239}Pu into the deep ocean were modelled and the predicted concentrations were compared. In general, the models agreed well at release point, but concentrations at the surface of the ocean were highly influenced by the way in which upwelling and sedimentation were represented. Although the models predicted different concentrations at the surface, the peak concentration was less sensitive to differences between the models than the variation of surface concentration with time. No single model always gave the highest surface concentrations for all radionuclides and for all times. The two compartment models agreed well for poorly sorbed radionuclides and the minor differences could be attributed to different parameter values for sedimentation rates. Both compartment models predicted that the peak doses would arise away from the release area.

16092 **(PB—88-120795/XAB) Methods of removing uranium from drinking water. 1. A literature survey. 2. Present municipal water treatment and potential removal methods.** Drury, J.S.; Michelson, D.; Ensminger, J.T.; Lee, S.Y.; White, S.K. (Oak Ridge National Lab., TN (USA)). Dec 1982. 103p. (ORNL/EIS—194). NTIS, PC A06/MF A01.

Literature was searched for methods of removing uranium from drinking water. U.S. manufacturers and users of water-treatment equipment and products were also contacted regarding methods of removing uranium from potable water. Based on the results of these surveys, it was recommended that untreated, partially treated, and finished water samples from municipal water-treatment facilities be analyzed to determine the extent of removal of uranium by presently used procedures, and that additional laboratory studies be performed to determine what changes are needed to maximize the effectiveness of treatments that are already in use in existing water-treatment plants.

16093 **(PB—88-124110/XAB) Four common diagnostic problems that inhibit radon mitigation.** Osborne, M.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1987. 5p. (EPA—600/J-87/100). NTIS, PC A02/MF A01.

Pub. in JAPCA, Vol. 37, No. 5, 604-606(May 1987).

This paper identifies four of the more significant diagnostic problems that have been observed during EPA's radon-mitigation efforts, explains why they are of concern, and, when possible, offers potential solutions. The problems are: (1) inconsistent subslab aggregate; (2) access to radon entry surfaces; (3) diurnal and seasonal variation in radon concentrations; and, (4) the impact of radon in water on radon in air.

16094 **Radium removal by a home water softener.** Lucas, H.F. (Argonne National Lab., IL, USA). *Journal of Environmental Radioactivity (London);* 5: No. 5, 359-362(1987). Contract W-31-109-ENG-38.

The efficiency of radium removal by a home water softener was evaluated in a manually-operated unit that had been in service for about 10 years. The concentrations of calcium, magnesium, and radium in the water provided during a 100-day period averaged 70.2 +- 0.6 mg liter/sup -1/, 24.8 +- 0.6 mg liter/sup -1/, and 0.355 +- 0.007 Bq liter/sup -1/, respectively. The concentration of radium in the effluent remained at 1.3 +-1.0% of the input level throughout the entire 100-day period. In contrast, the concentration of magnesium began to increase by 30 days. By 40 days, the hardness had increased so much that the homeowner would have initiated another recharge cycle. However, the experiment was allowed to continue until the magnesium content had reached 80% of the influent level. There is no indication that the efficiency of radium removal by this water softener was affected by age or past use. Radium was removed even after the effluent had become hard and a recharge cycle was needed.

5204 Thermal Effluents Monitoring And Transport

16095 **(NP—8751663, pp 37-42) Non-steady state flow of ground heat at the contact surface of a glacier stream to the subsoil.** Gereke, W. Mar 1987. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751663/JAW.

Universitaet Muenchen, Meteorologisches Institut. Wissenschaftliche Mitteilung.; no. 56.

In Work from the departments of the Meteorological Institute of the University of Munich.

A process was developed for the outflow of the Vernagtferner in Oetztal (Austria), by which the direct heat extraction from the soil due to occasional flooding on a day of sunshine can be estimated. The increase in water temperature due to this can be calculated.

16096 **(UBA-FB—81-122) Heat and moisture losses of heated rivers.** Guenneberg, F. (Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.); Umweltbundesamt, Berlin (Germany, F.R.)). 1985. 50p. (In German). Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).

This report comprises follow-up measurements with an installation conceived as follows: two thermally insulated tanks with an area of 6 m/sup 2/ each floated in the Moselle, the one having a water depth of 30 cm, the other 2 mm. As a result of their very different time constants their temperature differed from the equilibrium temperature by different amounts, and the components of heat exchange were different. In this way the course of the temperature and its causality were to be followed in order to improve the determination of the wind function. The aim of the project was essentially not achieved. With 7 refs., 20 figs..

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 16061, 16066

16097 **(PB—88-123146/XAB) American Samoa coastal management program and final environmental impact statement.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). 1980. 238p. (OCRM—87-17). NTIS, PC A11/MF A01.

The Territory of American Samoa has submitted its Coastal Management Program to the Office of Coastal Zone Management for approval. Approval would allow program administrative grants to be awarded to the Territory and require that federal actions be consistent with the Program (Part II) which is a comprehensive management program for coastal lands and waters and uses of these areas. It consists of numerous policies on diverse management issues which are enforced by various Territorial laws, and is the culmination of several years of program development.

5206 Regulations

REFER ALSO TO CITATION(S) 14728, 14729, 16062

16098 **(NIVA-O—80007) Evaluation system for water quality in lakes and rivers.** Rensvik, H.; Kjellberg, G.; Lindstroem, E.A.; Grande, M.; Henriksen, A.; Ormerod, K. (Norsk Inst. for Vannforskning, Oslo). Nov 1983. 78p. (In Norwegian). NTIS (US Sales Only), PC A05. Order Number DE88751188/JAW.

The report deals with a water quality evaluation system for lakes and rivers. The operational system is developed for simplified descriptions of general water qualities together with specific user criteria, and is based on a number of 5 environmental influences such as eutrophication, saprobiotic effects, acidification, and toxic and microbiological effects. General descriptions and variables with suggested classification of water qualities in the various categories of ecosystems are prepared, and specific user criteria for bathing and recreaton are given. The further needs for research and development are discussed regarding systems development, fundamental methods and testing. 12 drawings, 12 tables, 38 references.

16099 **(PB—88-111968/XAB) Survey of state groundwater quality protection legislation, 1985.** Rosoff, S. (National Conference of State Legislatures, Denver, CO (USA)). Apr 1987. 70p. NTIS, PC A04/MF A01.

The report surveys State legislation that was enacted in 1985, designed to protect ground water. Eight major categories of legislation are summarized: State-wide strategies, aquifer classification, standard setting, land use management, ground-water funds, agricultural chemicals, underground storage tanks, and water-use management. The report is divided into three sections: (1) comparison of State legislatures from 1985, (2) summary of all categories of legislation enacted in 1985, (3) summary of legislation on a category-by-category basis. Included in the document are the session law numbers (act or chapter) of the enacted legislation, and contacts to relevant State legislative staff for additional information.

16100 **(PB—88-124524/XAB) Quality assurance in computer simulations of groundwater contamination.** van der Hiejde, P.K.M. (International Ground Water Modeling Center, Indianapolis, IN (USA)). 1987. 9p. NTIS, PC A02/MF A01.

Pub. in Environmental Software, Vol. 2, No. 1, 19-25(1987).

In the development of policies and regulations for groundwater protection, in permitting, and in planning monitoring and remedial actions, the role of mathematical models is growing rapidly. Because water-resource management decisions should be based on technically and scientifically sound methods, quality assurance (QA) needs to be applied to groundwater modeling, both in model development and field studies, and should also play an important part in model selection. Important aspects of QA in groundwater model development are peer review, and verification and validation of the computer code and its underlying theoretical principles. The paper discusses the role of review and testing as part of an overall QA approach, and addresses QA in model selection and field application.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 14723

16101 **(NP—8751689) Enquete Commission 'Technology assessment; determination of framework conditions of technical developments'. Materials to Drucksache 10/6801. Vol. 2.** (Deutscher Bundestag, Bonn (Germany, F.R.)). Mar 1987. 418p. (In German). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88751689/JAW.

The Enquete Commission submits volumes in which part of its previous uncompleted stages of work, experience gained and knowledge regarding the procedure of estimating and assessing technical consequences and the problems examined is documented. Volume 2 documents the following events of the Enquete Commission: Public hearing on the subject of 'Human creativity and artificial intelligence'; symposium on the subject of 'Parliament and the challenge from technology'; colloquium on 'Legal aspects of estimating technical consequences'; and the working paper prepared for this. The latter represents a working up of this group of subjects, which will be of great importance for the work of future parliamentary estimates and assessments of technical consequences. (orig./HSCH).

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 14230, 14231, 14728, 16070, 16097

16102 **(DOE/EA—0327) 230-kV transmission line upgrade, Jamestown-Grand Forks, North Dakota: Environmental assessment.** (USDOE Western Area Power Administration, Washington, DC). 1987. 150p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88004912/JAW.

The proposed project would generally consist of increasing the right-of-way (ROW) width from 75 ft to 125 ft; replacing existing wood three-pole turning structures with taller structures of similar construction; raising the crossarms on the existing tangent structures to accommodate longer insulator strings while maintaining necessary ground clearance; and adding bayonets to the top of the existing tangent structures to raise and support the overhead ground wires. No significant impacts were identified from the resource investigations. Potential moderate impacts were identified for specific sites in the soils, ecological resources, land use, and visual resources components of the environment. The study identified an area of potential moderate land use conflict at the proposed site of the English Coulee retention area. Moderate impact to visual resources was identified at the Sheyenne River crossing due to its distinctive scenic quality. No cultural resources listed in the National Register of Historic Places, or eligible for listing, occur within the project area.

16103 (DOE/EA—0331) Buffalo Flat service: 115-kV transmission project: Environmental assessment. (USDOE Bonneville Power Administration, Portland, OR. Office of Engineering and Construction). Jul 1987. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005120/JAW.

The US Air Force has sited a radar transmitter at Buffalo Flat, near Christmas Valley, Oregon. This report discusses the environmental impacts of providing the electrical service for the installation. A 115 kV power transmission line will be built between LaPine and Buffalo Flat. Route alternatives as well as design alternatives are discussed. (ACR)

55 BIOMEDICAL SCIENCES, BASIC STUDIES

16104 Coupled dipoles in light scattering by randomly oriented chiral particles. Singham, S.B. (Life Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* 88: No. 3, 1522-1527(1 Feb 1988).

Light scattering by oriented and randomly oriented chiral particles is compared. It is shown that large magnitude terms in the scattered field products that contribute to the 2 x 2 off-block-diagonal matrix elements in the oriented particle scattering matrix make no contribution in the orientation averages. A model calculation for a simple chiral particle is described.

5502 Biochemistry

REFER ALSO TO CITATION(S) 14400, 14406, 14407, 15389, 15390, 16125, 16127, 16128, 16136, 16181, 16202, 16237, 16239, 16243

16105 (DOE/EV/70200—T2) Genetic structure of natural populations: Final technical report. Ayala, F.J. (California Univ., Davis (USA). Dept. of Genetics). 31 Dec 1987. Contract AS03-76EV70200. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005019/JAW.

We determined the LD_{50} for individuals with any one of four genetic constitutions. The LD_{50} was in kR units (S and F refer to the two common alleles found in natural populations and N is a mull allele) S/S 5.31, F/F 4.61, S/F 4.19, N/N 3.16. These results are as expected under the hypothesis the SOD is involved in radioresistance and the degree of protection is a function of SOD specific activity. S codes for an allozyme that has the highest in vitro specific activity while N reduces the amount of enzyme to 3.5% of the normal level. Natural selection experiments in population cages were carried out for 13 generations. In control populations, the frequency of the S allele decreases from the initial frequency of 0.50 to an equilibrium value 0.1 to 0.2 in about 10 generations. In populations with the larvae receiving 4 KR in each generation, s reaches an equilibrium frequency of 0.6; when the irradiation was no longer applied, the frequency of S started declining, eventually reaching 0.1 to 0.2. These results corroborate the hypothesis that SOD protects against irradiation and that the degree of protection is correlated by the in vitro specific activity of the allozymes. 29 refs., 4 tabs.

16106 (DOE/OR/00033—T382) Optimization of the southern electrophoretic transfer method. Allison, M.A.; Fujimura, R.K. (Oak Ridge National Lab., TN (USA)). [1987]. Contract AC05-76OR00033. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004527/JAW.

The technique of separating DNA fragments using agarose gel electrophoresis is essential in the analysis of nucleic acids. Further, after the method of transferring specific DNA fragments from those agarose gels to cellulose nitrate membranes was developed in 1975, a method was developed to transfer DNA, RNA, protein and ribonucleoprotein particles from various gels onto diazobenzyloxymethyl (DBM) paper using electrophoresis as well. This paper describes the optimum conditions for quantitative electrophoretic transfer of DNA onto nylon membranes. This method exemplifies the ability to hybridize the membrane more than once with specific RNA probes by providing sufficient retention of the DNA. Furthermore, the intrinsic properties of the nylon membrane allow for an increase in the efficiency and resolution of transfer while using somewhat harsh alkaline conditions. The use of alkaline conditions is of critical importance since we can now denature the DNA during transfer and thus only a short pre-treatment in acid is required for depurination. 9 refs., 7 figs.

16107 (INIS-BR—910, pp 16) Structure and function of proteins of immunological interest. Endo, S.; Muto, Y.; Ito, W.; Higashi, N.; Nishimura, M.; Arata, Y. (Tokyo Univ., Japan). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16108 (INIS-BR—910, pp 16) /sup 31/P and 2-dimensional NMR methodology for assignment of /sup 31/P and /sup 1/H signals of oligonucleotides. Gorenstein, D.G.; Schroeder, S.; Miyasaki, M.; Fu, J.; Jones, C.; Abuaf, P. (Purdue Univ., Lafayette, IN, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16109 (INIS-BR—910, pp 17) Molecular interactions at the membrane surface. Watts, A. (Oxford Univ., UK. Dept. of Biochemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16110 (INIS-mf—11007) Lateral interactions in the photoreceptor membrane: a NMR study. Mollevanger, L.C.P.J. (Katholieke Univ. Nijmegen (Netherlands)). 30 Jan 1987. 175p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700214/JAW.

The photoreceptor membrane has an exceptionally high content of polyunsaturated fatty acyl chains combined with a high amount of phosphatidyl ethanolamine. It is situated in a cell organelle, the rod outer segment, with a high biological activity in which controlable trans-membrane currents of different ions play an important role. These characteristics make it a very interesting biological membrane to search for the existence of non-bilayer structures. Therefore, in this thesis a detailed study of the polymorphic phase behavior of the rod outer segment photoreceptor lipids was undertaken, concerning modulation of the polymorphic phase behavior of photoreceptor membrane lipids by divalent cations and temperature, polymorphism of the individual phospholipid classes phosphatidylethanolamine and phosphatidylserine and effects of cholesterol, bilayer stabilization by (rhod)opsin. Morphologically intact rod outer segment possesses a large magnetic anisotropy. This property is used to obtain ^{31}P-NMR of oriented photoreceptor membranes which allows spectral analysis and identification of individual phospholipid classes, and allows to study lateral lipid diffusion in intact disk membranes. The power of high resolution solid state ^{13}C-NMR to study the conformation of the chromophore in rhodopsin is demonstrated.

16111 (INIS-mf—11008) NMR studies of DNA structures in solution. Influence of the bases on the conformational behavior. Rinkel, L.J. (Rijksuniversiteit Leiden (Netherlands)). 4 Mar 1987. 182p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700215/JAW.

This thesis describes the conformational analysis of some polynucleotides in aqueous solution. A new graphical method is presented as an aid in the pseudorotational analysis of the sugar rings in DNA by means of sums of proton-proton coupling constants. 433 references, 39 figures, 35 tables.

16112 (UCRL—97977) Establishing the order of human chromosome-specific DNA fragments. Carrano, A.V.; Branscomb, E.W.; de Jong, P.J.; Watkins, B.W.; Mohrenweiser, H.W.; Phipps, J.; Ashworth, L.K.; Summers, L.; Pederson, L.; Slezak, T. (Lawrence Livermore National Lab., CA (USA)). 13 Jan 1988. Contract W-7405-ENG-48. 25p. (CONF-8709214—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005216/JAW.

From Workshop on biotechnology and the human genome: innovations and impacts; Upton, NY, USA (14 Sep 1987).

While the coupling of the cosmid and large fragment approaches offers a significant improvement over either method alone, the establishment of a single contig for chromosome 19 is not a certainty. The inability to clone some DNA sequences, the nonuniform representation of cloned sequences, and the presence of highly repeated DNA sequences, which may confuse the overlap analysis, all confound this ultimate goal. It is likely that new methods may simplify or replace some of the steps involved and research into and development of such methods is critical to any large scale commitment to ordering and subsequently understanding the human genome. Further, the initiative is sufficiently large that coordination of activities of all interested parties at the national as well as international level is essential. 23 refs., 5 figs.

16113 Complete mapping of the proteins in the small ribosomal subunit of Escherichia coli. Capel, M.S.; Engelman, D.M.; Freeborn, B.R.; Kjeldgaard, M.; Langer, J.A.; Ramakrishnan, V.; Schindler, D.G.; Schneider, D.K.; Schoenborn, B.P.; Sillers, I.Y.; . (Brookhaven National Lab., Upton, NY). *Science (Washington, D.C.);* **238**: No. 4832, 1403-1406(4 Dec 1987).

The relative positions of the centers of mass of the 21 proteins of the 30S ribosomal subunit from Escherichia coli have been determined by triangulation using neutron scattering data. The resulting map of the quaternary structure of the small ribosomal subunit is presented, and comparisons are made with structural data from other sources.

16114 Structural studies of the molybdenum site in the MoFe protein and it FeMo cofactor by EXAFS. Conradson, S.D.; Burgess, B.K.; Newton, W.E.; Mortenson, L.E.; Hodgson, K.O. (Stanford, Univ., CA). *Journal of the American Chemical Society;* **109**: No. 24, 7507-7515(25 Nov 1987).

Nitrogenase is a complex bacterial enzyme system that is responsible for the conversion of atmospheric N_2 to ammonia. The structure and function of molybdenum in the MoFe protein of this system has been the subject of a number of investigations, including the use of X-ray absorption spectroscopy. This paper reports the results of the authors recent studies on several states of the MoFe protein and its FeMo cofactor (which is extruded by treatment with N-methylformamide). Mo K-edge (XANES) and extended fine structure (EXAFS) spectra have been recorded to high energies above the absorption edge with excellent signal-to-nose on the semireduced form of the MoFe protein from both Clostridium pasteurianum and Azotobacter vinelandii and on the as isolated FeMo-co and FeMo-co treated with benzenethiol and with benzeneselenol. In all of the states studied, EXAFS results reveal that the Mo is in an environment that contains two or three oxygen (or nitrogen) atoms at 2.10-2.12 A, three to five S atoms at 2.37 A, and three to four Fe atoms at 2.68-2.70 A. The numbers of these ligands change upon removal of the cofactor from the protein as discussed in the paper. For FeMo-co, comparisons also show that thil/selenol is not binding directly to the Mo site. The results of these EXAFS (and their XANES published earlier) definitely show the presence of several low-Z ligands and are not compatible with a tetrahedral arrangement of only nearest S neighbors at the Mo site.

16115 Chromatin higher-order structure studied by neutron scattering and scanning transmission electron microscopy. Gerchman, S.E.; Ramakrishnan, V. (Brookhaven National Lab., Upton, NY). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 22, 7802-7806(Nov 1987).

Neutron scattering in solution and scanning transmission electron microscopy were simultaneously done on chicken erythrocyte chromatin at various salt and magnesium concentrations. We show that chromatin is organized into a higher-order structure even at low ionic strength and that the mass per unit length increases continuously as a function of salt concentration, reaching a limiting value of between six and seven nucleosomes per 11 nm. There is no evidence of a transition from a 10-nm to a 30-nm fiber. Fiber diameter is correlated with mass per unit length, showing that both increase during condensation. We also find that there is no essential difference between the mass per unit length measured by scanning transmission electron microscopy and neutron scattering in solution, showing that the ordered regions seen in micrographs are representative of chromatin in solution.

16116 UDPglucose pyrophosphorylase activity in the diatom Cyclotella cryptica. Pathway of chrysolaminarin biosynthesis. Roessler, P.G. (Solar Energy Research Institute, Golden, CO). *Journal of Phycology;* **23**: No. 3, 494-498(Sep 1987).

UDPglucose pryophosphorylase activity was detected in cell-free extracts of the diatom Cyclotella cryptica T13L Reimann, Lewin and Guillard. When assayed in the direction of UDPglucose formation, the enzyme had maximal activity at pH 7.8 and was stimulated by Mg^{2+} and Mn^{2+} ions. 3-Phosphoglycerate and inorganic phosphate had little effect on enzymatic activity, and the enzyme was relatively insensitive to feedback inhibition from UDPglucose. A glucan was formed from UDP-[^{14}C]glucose in cell-free extracts of C. cryptica. This glucan had a median molecular weight of 4600 (as determined by gel filtration chromatography) and could be hydrolyzed by laminarinase. Partial acid hydrolysis of the glucan resulted in the formation of glucose and laminaribiose, but not cellobiose. These results suggest that the synthesis of chrysolaminarin (the major storage carbohydrate of diatoms) occurs via the activity of UDPglucose pyrophosphorylase, followed by glucosyl transfer from UDPglucose to the growing $\beta(1 \rightarrow 3)$-linked glucan.

16117 Calmodulin stimulation of calcium transport in carrot microsomal vesicles. Pierce, W.S.; Sze, H. (Univ. of Maryland, College Park). *Plant Physiology, Supplement;* **83**: No. 4, 53(Apr 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

ATP-dependent $^{45}Ca^{2+}$ uptake into microsomal vesicles isolated from cultured carrot cells (Daucus carota Danvers) was stimulated 2-3 fold by 5 ug/ml calmodulin (CaM). Microsomal vesicles separated with a linear sucrose gradient showed two peaks with CaM-stimulated Ca^{2+} uptake activities. One peak (at 1.12 g/cc) comigrated with the activity of the antimycin A-insensitive NADH-dependent cytochrome c reductase. This transport activity was enhanced 10-20 fold by 10 mM oxalate and appeared to be associates with vesicles derived primarily from the ER. The other peak of CaM-stimulated Ca^{2+} uptake (at 1.17 g/cc) was not affected by oxalate. These vesicles are probably derived from the plasma membrane. Preliminary experiments with the low-density vesicles (ER) vesicles, indicate that inositol-1,4,5-trisphosphate caused a transient reduction in intravesicular Ca^{2+}. These results are consistent with the ER being an important site of intracellular Ca^{2+} regulation.

16118 Photosynthetic CO_2 fixation in guard cells (GC). Gotow, K.; Taylor, S.; Zeiger, E. (Univ. of California, Santa Cruz). *Plant Physiology, Supplement;* **83**: No. 4, 34(Apr 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

Recent studies indicate that carbon metabolism in GC is modulated by light quality. The fate of $^{14}CO_2$ supplied to highly purified Vicia GC protoplasts irradiated with red light was investigated. The suspension was stirred at 25°C and dark-adapted for 5 min. After 5 min. in red light, 4.8 uCi of $NaH^{14}CO_3$ was added (final concentration: 100 uM). Metabolism was quenched after 30 s with boiling ethanol. Anionic compounds were separated by 2D PC and TLC, and quantified. Rates of CO_2 fixation were 5- to 8-fold higher in the light. In the dark, malate and aspartate had 90% of the total label; in the light, 3-PGA, sugar monophosphates (SMP) and sugar diophosphates (SDP) had up to 60% of the label. Phosphates treatment and rechromatography of labelled SDP showed the presence of ribulose, a specific PCRP metabolite. In time-course

experiments, labelled 3-PGA was detected within 5 s. With time, the percentage of label in 3-PGA decreased and that in SMP increased. The authors conclude that 3-PGA is a primary carboxylation product of the PCRP in GC and that the activity of the PCRP and PEP-carboxylase is metabolically regulated.

16119 **Chromatin structure near transcriptionally active genes.** Felsenfeld, G.; Emerson, B.M.; Jackson, P.D.; Lewis, C.D.; Nickol, J.M. (National Institutes of Health, Bethesda, MD). pp 63-74 of Evolutionary perspectives and the new genetics: [Final report]. Gershowitz, H.; Rucknagel, D.L.; Tashian, R.E. (eds.). New York, NY; Alan R. Liss, Inc. (1986). (DOE/ER/60318—1; CONF-8506364—).

From International symposium honoring Dr. James V. Neel; Ann Arbor, MI, USA (17 Jun 1985).

Hypersensitive domains are the most prominent features of transcriptionally active chromatin. In the case of the β/sup A/-globin gene, it seems likely that two or more protein factors are capable of binding to the DNA so tightly that the nucleosome is prevented from binding. We have shown that nucleosomes, once bound in the assembly process in vitro, cannot be displaced. The interaction of the 5S gene transcription factor TFIIIA with its target DNA also is blocked by histones, and it has been suggested that the activation of the gene must occur during replication, before histones are reassembled on the DNA. We suppose that a similar mechanism may govern the binding of the hypersensitivity factors. It should be noted that nucleosomes are excluded not only from the sites to which the factors bind, but also from the regions between the two domains and at either side. 12 refs., 6 figs.

16120 **Homologous pairing and strand exchange mediated by recA nucleoprotein filaments and networks.** Radding, C.M. (Yale Univ. School of Medicine, New Haven, CT). pp 77-94 of Evolutionary perspectives and the new genetics: [Final report]. Gershowitz, H.; Rucknagel, D.L.; Tashian, R.E. (eds.). New York, NY; Alan R. Liss, Inc. (1986). (DOE/ER/60318—1; CONF-8506364—).

From International symposium honoring Dr. James V. Neel; Ann Arbor, MI, USA (17 Jun 1985).

Prior to the studies on recA protein, the only known molecular basis for homologous pairing was the renaturation of complementary single strands that is promoted by helix destabilizing proteins. RecA protein, by contrast, pairs single-stranded or partially single-stranded DNA with duplex DNA by the synaptic mechanism reviewed here. The organization of recA protein on single-stranded DNA results in a nucleoprotein filament that is polyvalent with regard to weak binding sites for duplex DNA, which has the effect of concentrating single-stranded and double-stranded DNA and thereby facilitating the search for homology. The structure of the helical nucleoprotein filament determines how the sequences in the single strand are matched to their complements embedded in the duplex DNA. This process involves adjustment of the difference between the axial separation of bases in the filament and that in naked duplex DNA via a rapid increase in pitch of the parental duplex DNA when homologous recognition occurs. The ability of recA protein to polymerize on single-stranded DNA to form a specific and highly structured filament that efficiently promotes homologous pairing in vitro suggests for it a role in genetic recombination. The self-sufficiency of the recA nucleoprotein filament for rapid homologous pairing, suggests that this part of homologous recombination may not require additional undiscovered co-factors. RecA protein also acts on broken DNA molecules, one substrate molecule must be single-stranded or partially single-stranded. 66 refs., 8 figs., 1 tab.

16121 **Gene conversion.** Holliday, R. (National Institute for Medical Research, London, United Kingdom). pp 95-107 of Evolutionary perspectives and the new genetics: [Final report]. Gershowitz, H.; Rucknagel, D.L.; Tashian, R.E. (eds.). New York, NY; Alan R. Liss, Inc. (1986). (DOE/ER/60318—1; CONF-8506364—).

From International symposium honoring Dr. James V. Neel; Ann Arbor, MI, USA (17 Jun 1985).

An overview of gene conversion is provided. The discussion includes the discovery of gene conversion, marker events, biological evolution, DNA repair and the possibility of methylation of cytosine as a modulator in gene transcription. 54 refs., 1 fig. (DT)

16122 **Overreplication of DNA and the rapid generation of genomic change.** Schimke, R.T.; Sherwood, S.W.; Hill, A.B. (Stanford, Univ., CA). pp 109-117 of Evolutionary perspectives and the new genetics: [Final report]. Gershowitz, H.; Rucknagel, D.L.; Tashian, R.E. (eds.). New York, NY; Alan R. Liss, Inc. (1986). (DOE/ER/60318—1; CONF-8506364—).

From International symposium honoring Dr. James V. Neel; Ann Arbor, MI, USA (17 Jun 1985).

Our laboratory has been studying the process whereby cultured animal cells and human tumors become resistant to methotrexate as a result of amplificatin of the dihydrofolate reductase gene. This paper describes our current understanding of the mechanism of gene amplification, and provides an explanation for the rapid generation of genome changes. We propose that any cell that is perturbed during the process of DNA replication can overreplicate DNA, generating a substratum of free DNA strands which can undergo different recombinatin events to generate a variety of chromosomal aberrations-rearrangements. We propose that this phenomenon occurs in germ cell lineages during the rapid mitotic expansion phase, thereby occasionally fixing such chromosomal changes in gametes. 33 refs., 1 fig.

16123 **Molecular evidence on the ape subfamily hlarninae.** Goodman, M. (Wayne State Univ. School of Medicine, Detroit, MI). pp 121-132 of Evolutionary perspectives and the new genetics: [Final report]. Gershowitz, H.; Rucknagel, D.L.; Tashian, R.E. (eds.). New York, NY; Alan R. Liss, Inc. (1986). (DOE/ER/60318—1; CONF-8506364—).

From International symposium honoring Dr. James V. Neel; Ann Arbor, MI, USA (17 Jun 1985).

Recent studies using amino acid sequence data from proteins, DNA-DNA hybridization distances and nucleotide sequences from mitochondrial and nuclear genomes support the concept of Hominidae as an ape subfamily grouping Homo, Pan, and Gorilla. Moreover this modern molecular evidence also supports the idea that humans, chimpanzees, and gorillas are the sole termini of an evolutionarily late diverging clade. Depending on the molecular data set and the molecular clock model employed, the divergence times calculated for the last common ancestor of Homo, Pan, and Gorilla range from less than 2 MYA (million years ago) to about 8 MYA. 35 refs., 1 fig.

5503 Cytology

REFER ALSO TO CITATION(S) 16267

16124 **(PNL-SA—14838) A modified JB-4 method for cutting plastics with a rotary microtome.** Gideon, K.M. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76RL01830. 5p. (CONF-8710185—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003422/JAW.

From 13. annual symposium/convention of the National Society for Histotechnology; Seattle, WA, USA (11 Oct 1987).

The procedure described is used in our laboratory on tissue to be embedded in glycol methacrylate and cut at 2 microns. A list of the solutions required is attached.

16125 **Automated single-cell manipulation and sorting by light trapping.** Buican, T.N.; Smyth, M.J.; Crissman, H.A.; Salzmann, G.C.; Stewart, C.C.; Martin, J.C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Optics;* **26**: No. 24, 5311-5316(15 Dec 1987).

Following the recently reported trapping of biological particles by finely focused laser beams, we report on the automated micromanipulation of cells and other microscopic particles by purely optical means as well as on a newly observed interaction between particles in the trapping beam. A simple instrument is described which allows single cells to be positioned with high accuracy, transported over several millimeters, and automatically sorted on the basis of their optical properties. These operations are performed inside a small enclosed chamber without mechanical contact or significant fluid flow. Potential applications of this technique in experimental cell biology are discussed.

16126 **Influence of a reconstituted basement membrane and its components on casein gene expression and secretion in mouse mammary epithelial cells.** Li, M.L.; Aggeler, J.; Farson, D.A.; Hatier, C.; Hassell, J.; Bissell, M.J. (Lawrence Berkeley Lab., CA). *Proceedings of the National Academy of Sciences of the United States of America;* 84: No. 1, 136-140(Jan 1987). Contract AC03-76SF00098.

When primary mouse mammary epithelial cells are cultured on plastic, they rapidly lose their ability to synthesize and secrete most milk proteins even in the presence of lactogenic hormones, whereas cells cultured on release type I collagen gels show greatly enhanced mRNA levels and secretion rates of β-casein and of some other milk proteins. The authors show here that culture on a reconstituted basement membrane from Engelbreth-Holm-Swarm tumor (EHS) allows > 90% of cells to produce high levels of β-casein. By comparison, 30-40% of cells on released type 1 gels and only 2-10% of cells on plastic express β-casein after 6 days in culture. Because only 40% of cells from late pregnant gland produced β-casein before culture, the EHS matrix can both induce and maintain an increased level of casein gene expression. Individual basal lamina components were also evaluated. Type IV collagen and fibronectin had little effect on morphology and β-casein mRNA levels. In contrast, both laminin and heparan sulfate proteoglycan increased β-casein mRNA levels. Profound morphological differences were evident between cells cultured on plastic and on EHS matrix, the latter cells forming ducts, ductules, and lumina and resembling secretory alveoli. These results emphasize the vital role of the extracellular matrix in receiving and integrating structural and functional signals that can direct specific gene expression in differentiated tissues.

5504 Genetics

REFER ALSO TO CITATION(S) 14407, 14408, 16112, 16121, 16122, 16123, 16227, 16236, 16237, 16255, 17160

16127 **(DOE/ER/60589—1) Report of the matrix of biological knowledge workshop.** Morowitz, H.J.; Smith, T. (Santa Fe Inst., NM (USA)). 30 Oct 1987. Contract FG04-87ER60589. 155p. (CONF-8707138—). NTIS, PC A08. Order Number DE88002640/JAW.

From Matrix of biological knowledge workshop; Santa Fe, NM, USA (13 Jul 1987).

Current understanding of biology involves complex relationships rooted in enormous amounts of data. These data include entries from biochemistry, ecology, genetics, human and veterinary medicine, molecular structure studies, agriculture, embryology, systematics, and many other disciplines. The present wealth of biological data goes beyond past accumulations now include new understandings from molecular biology. Several important biological databases are currently being supported, and more are planned; however, major problems of interdatabase communication and management efficiency abound. Few scientists are currently capable of keeping up with this ever-increasing wealth of knowledge, let alone searching it efficiently for new or unsuspected links and important analogies. Yet this is what is required if the continued rapid generation of such data is to lead most effectively to the major conceptual, medical, and agricultural advances anticipated over the coming decades in the United States. The opportunity exists to combine the potential of modern computer science, database management, and artificial intelligence in a major effort to organize the vast wealth of biological and clinical data. The time is right because the amount of data is still manageable even in its current highly-fragmented form; important hardware and computer science tools have been greatly improved; and there have been recent fundamental advances in our comprehension of biology. This latter is particularly true at the molecular level where the information for nearly all higher structure and function is encoded. The organization of all biological experimental data coordinately within a structure incorporating our current understanding - the Matrix of Biological Knowledge - will provide the data and structure for the major advances foreseen in the years ahead.

16128 **Cloning of a human radiation repair gene.** Chen, D.J.; MacInnes, M.A.; Jeggo, P.A.; Reynolds, R.J.; Strniste, G.F.; Tesmer, J.G. (Genetics Group, Life Sciences Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 106 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Substantial progress has been made towards cloning a human repair gene necessary for the rejoining of radiation-induced DNA-double strand breaks. The experiments on human DNA and linearized plasmid DNA are described. The plasmid's ability to complement xrs-6 cell is described.

16129 **Evolutionary perspectives and the new genetics: [Final report].** Gershowitz, H.; Rucknagel, D.L.; Tashian, R.E. (eds.). New York, NY; Alan R. Liss, Inc. (1986). 191p. (DOE/ER/60318—1; CONF-8506364—). Alan R. Liss, Inc., 41 East 11th Street, New York, NY 10003. Order Number TI87013683/JAW. Contract FG02-85ER60318.

From International symposium honoring Dr. James V. Neel; Ann Arbor, MI, USA (17 Jun 1985).

This volume contains papers presented by participants at a symposium on Evolutionary Perspectives and the New Genetics held at the University of Michigan, June 17 and 18, 1985, honoring Dr. James V. Neel on the occasion of his official retirement. Throughout his illustrious and productive career, Dr. Neel has always maintained a strong interest in evolution, readily apparent in his many publications dealing with mutation rates, population genetics, and more directly with human evolution. It was therefore, appropriate that a conference held in his honor should summarize some of the recent developments in molecular and population genetics, in the hope that they might serve to shed light on the complex mechanisms underlying the patterns of organismal evolution. Toward that end, we are pleased that a number of distinguished scientists agreed to present the results of their recent research.

16130 **Scientist, journalist, orchidist: Will the real James V. Neel please stand up.** Schull, W.J. (Univ. of Texas Health Science Center, Houston). pp 1-9 of Evolutionary perspectives and the new genetics: [Final report]. Gershowitz, H.; Rucknagel, D.L.; Tashian, R.E. (eds.). New York, NY; Alan R. Liss, Inc. (1986). (DOE/ER/60318—1; CONF-8506364—).

From International symposium honoring Dr. James V. Neel; Ann Arbor, MI, USA (17 Jun 1985).

A brief review of the scientific achievements of James V. Neel is related. His contributions to the development of clinical genetics are described chronologically. 13 refs. (DT)

16131 **Population structure.** Cavalli-Sforza, L.L. (Stanford Univ. School of Medicine, CA). pp 13-30 of Evolutionary perspectives and the new genetics: [Final report]. Gershowitz, H.; Rucknagel, D.L.; Tashian, R.E. (eds.). New York, NY; Alan R. Liss, Inc. (1986). (DOE/ER/60318—1; CONF-8506364—).

From International symposium honoring Dr. James V. Neel; Ann Arbor, MI, USA (17 Jun 1985).

The very rough model of expansion of hunter-gatherers the author has given can be usefully supplemented with a simulation, but even in the current absence of one it is clear that the expansion through the Bering strait to the Americas was very different from the two other prehistorical expansions better known to us, those to Europe and to Central Africa. Both of these were expansions of farmers, hence at relatively high densities, and drift was almost negligible. This budding model may be helpful also for understanding drift in the expansion to Australia, which must have been high; and perhaps also the earlier ones of Homo sapiens sapiens from Asia between 40 and 40,000 years ago, about which so little is known today. The author would like to stress the importance of a more dynamic kind of approach to population structure, which may add more than the classical static models to the understanding of the key phenomena in human evolution. 30 refs., 2 figs., 2 tabs.

16132 Inbreeding and the balance between selection and mutation. Li, C.C. (Univ. of Pittsburgh, PA). pp 31-44 of Evolutionary perspectives and the new genetics: [Final report]. Gershowitz, H.; Rucknagel, D.L.; Tashian, R.E. (eds.). New York, NY; Alan R. Liss, Inc. (1986). (DOE/ER/60318—1; CONF-8506364—).

From International symposium honoring Dr. James V. Neel; Ann Arbor, MI, USA (17 Jun 1985).

The first half of the paper described the structure of a large population caused by subdivision and inbreeding. Then, in the second half, it shows the structure of a population does not play any role in determining the incidence of the recessive genotype. The latter is determined entirely by the ratio of the mutation rate to the selection coefficient. The recessive gene frequency, however, depends much on the structure of the population. The effect of relaxing inbreeding and subdivision on the rise and fall (rather the fall and rise) of the recessive gene frequency has been discussed. 6 refs., 3 tabs.

16133 The relationship between the common mutations of the α gene cluster and its evolutionary history. Weatherall, D.J.; Higgs, D.R.; Clegg, J.B.; Hill, A.S.; Nicholls, R.; Wainscoat, J.S. (Univ. of Oxford, John Radcliffe Hospital, United Kingdom). pp 47-62 of Evolutionary perspectives and the new genetics: [Final report]. Gershowitz, H.; Rucknagel, D.L.; Tashian, R.E. (eds.). New York, NY; Alan R. Liss, Inc. (1986). (DOE/ER/60318—1; CONF-8506364—).

From International symposium honoring Dr. James V. Neel; Ann Arbor, MI, USA (17 Jun 1985).

The α globin gene cluster is far from static. It shows remarkable diversity within and among populations, both in gene number and the pattern of polymorphisms involving the hypervariable regions. The deletions which have given rise to α^0 thalassemia appear to have resulted from rare genetic events and the affected chromosomes have been distributed among localized populations by selection. On the other hand, the deletions which have given rise to at least one of the α^+ thalassemias seem to have occurred on multiple occasions in different populations. The genesis of this condition, the commonest single gene disorder, may reflect the concerted evolution of the α globin genes, and the α^+ thalassemias may have arisen as a by-product of this evolutionary process. The existence of such a polymorphic gene family and the fact that its mutations are the commonest single gene disorders in man, provide us with a remarkable, natural model for studying population genetics at the molecular level. Further analysis of this cluster, and of the β globin genes, may provide valuable information about the timing of racial diversions, population movements, and the molecular events which have helped to maintain such high gene frequencies for some of the mutations of these loci. 17 refs., 3 figs.

16134 Stochastic errors in DNA evolution and molecular phylogeny. Nei, M. (Univ. of Texas, Houston). pp 133-147 of Evolutionary perspectives and the new genetics: [Final report]. Gershowitz, H.; Rucknagel, D.L.; Tashian, R.E. (eds.). New York, NY; Alan R. Liss, Inc. (1986). (DOE/ER/60318—1; CONF-8506364—).

From International symposium honoring Dr. James V. Neel; Ann Arbor, MI, USA (17 Jun 1985).

Phylogenetic trees constructed from molecular data can be erroneous for various reasons. Two important factors are the stochastic error or nucleotide substitution and polymorphism of different sequences within populations. To see the effects of these factors on the probability of obtaining the correct topology, mathematical studies are conducted with special reference to the branching order of the human-chimpanzee-gorilla. It is shown that a few thousand nucleotides must be examined for many unlinked genes to resolve this branching order. It is also shown that protein electrophoresis may produce a more reliable tree than mtDNA if a large number of loci are studied and the populations studied are closely related. 35 refs., 1 fig., 2 tabs.

16135 An estimation of the number of invariable sites is necessary for the accurate estimation of the number of nucleotide substitutions since a common ancestor. Fitch, W.M. (Univ. of Wisconsin, Madison). pp 149-159 of Evolutionary perspectives and the new genetics: [Final report]. Gershowitz, H.; Rucknagel, D.L.; Tashian, R.E. (eds.). New York, NY; Alan R. Liss, Inc. (1986). (DOE/ER/60318—1; CONF-8506364—).

From International symposium honoring Dr. James V. Neel; Ann Arbor, MI, USA (17 Jun 1985).

A major problem in the comparison of homologous nucleotide sequences is the determination of the total number of nucleotide substitutions that have occurred in their genes since the two sequences had a common ancestor. This estimate of substitutions is necessarily based on counting the number and kind of nucleotide differences observed in their homologous alignment and on the number of aligned residues in the alignment. We have been able to divide such data into two groups, each evolving with a constant fraction of all substitutions being transitions that sum to fit the observations. The only added constraint is that some of the nucleotide sites be invariable, namely 30% of the third positions of codons and 60% of the first two positions of codons. This amounts to half of all the coding positions in this fragment. It appears that current estimates of the number of substitutions required to account for observed differences and which assume that all sites are variable are subject to serious doubt. The total number of substitutions can be substantially underestimated for the older divergences with the result that, even if substitutions are in fact linear with time, the estimates of their number may be very non-linear with time if one fails to take into account the number of invariable sites and their number is, in this case, sizable. The method of estimating the number of variable positions used in this paper is crude. What this paper shows is that a good method is an important goal, especially if molecular data are to be used as clocks to estimate times of divergence. 22 refs., 3 figs., 1 tab.

16136 Evolution and tinkering: The molecular genetics of bacterial adaption. Hartl, D.L. (Washington Univ. School of Medicine, St. Louis, MO). pp 161-175 of Evolutionary perspectives and the new genetics: [Final report]. Gershowitz, H.; Rucknagel, D.L.; Tashian, R.E. (eds.). New York, NY; Alan R. Liss, Inc. (1986). (DOE/ER/60318—1; CONF-8506364—).

From International symposium honoring Dr. James V. Neel; Ann Arbor, MI, USA (17 Jun 1985).

The prototypic bacterial selection experiments, often referred to as directed evolution, attempt to produce strains that can grow by means of the utilization of novel metabolic compounds. Strains of bacteria have been tested for their ability to ferment sugars that are rare or uncommon in nature. For example, one strain, Klebsiella pneumoniae variety oxytoca, which at first grew very poorly on xylitol, gave rise to mutants that utilized the sugar effectively. Subsequent analysis showed that the critical mutation resulted in constitutive production of ribitol operon. The acquisition of xylitol utilization illustrates that preexisting enzymes can sometimes accept, even if poorly, a novel substrate. Also, a potentially recruitable enzyme that is not induced by the novel substrate can by spontaneous mutations that release the enzyme from regulatory control be favored by selection. Release from control is illustrated in the evolution of xylitol utilization by the constitutive production of ribotol dehydrogenase. Recruitment and release from control are principles of wide application in directed evolution. 57 refs.

5505 Metabolism

REFER ALSO TO CITATION(S) 14405, 16136

16137 (INIS-BR—910, pp 102) Comparison of methods for stopping metabolism of rat brain for in 'in vitro' studies by NMR. Conti, F.; Delfini, M.; Miccheli, A.; Aureli, T.; Di Cocco; Calderini, G. (Universita La Sapienza, Rome. Dipt. di Chimica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16138 (INIS-BR—910, pp 108) **Incorporation into serum cholesterol from exogeneous (Cholesterol-4-C13) and, endogeneous (DL-mevalonolactone-2-C13, and sodium acetate-1-C13) sources by C13 NMR.** Scott, R.A.; Reeves, L.W. (Waterloo Univ., Ontario, Canada). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16139 (INIS-mf—10795, pp 18) **Enrichment of iron contained in tissues and blood in the area around cuts.** Lux, F.; Trebert Haeberlin, S.; Forth, W.; Schaefer, S.G.; Bluemel, G.; Erhardt, W. (Technische Univ. Muenchen, Garching, Germany, F.R. Inst. fuer Radiochemie; Muenchen Univ., Germany, F.R. Inst. fuer Pharmakologie und Toxikologie; Technische Univ. Muenchen, Germany, F.R. Inst. fuer Experimentelle Chirurgie). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

5506 Medicine

REFER ALSO TO CITATION(S) 15508, 16196, 16217, 16218, 16218, 17171, 17172, 17256

16140 **(AERE-M—3528) Methods for the performance estimation of computerised tomography apparatus.** Hutchinson, I.G. (UKAEA Atomic Energy Research Establishment, Harwell. Instrumentation and Applied Physics Div.). Jun 1986. 3p. H.M. Stationery Office, London, price Pound 4.00.

In this paper a set of formulae is given which should prove useful for predicting the performance capabilities of computerized tomography data collection facilities.

16141 **(CEA-CONF—9078) Use of ^{76}Br-bromospiperone for the analysis of dopamine receptors in neuroleptic treated patients.** Maziere, B.; Cambon, H.; Baron, J.C.; Loc'h, C. (CEA, 91 - Orsay (France). Service Hospitalier Frederic Joliot). Jun 1987. 6p. (CONF-8706248—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751550/JAW.

From 6. international congress on catecholamines; Jerusalem, Israel (15 Jun 1987).

The determination of the optimal prescription dosage of neuroleptic medications is of great importance to optimize the therapeutic response and to minimize the occurrence of tardive dyskinesia and other side-effects. PET, a non-invasive methodology which provides in-vivo the actual binding (occupation) of brain dopamine receptors, can be used as an in-vivo radioreceptor assay to indirectly estimate the neuroleptic tissue levels. In this study, 76Br-BSP was used in conjunction with PET to provide a semi-quantitative estimate of the neuroleptic (D2) binding sites occupancy rate during and following oral treatment by neuroleptics. On neuroleptic treatment, the fraction of unoccupied sites showed a striking dose-dependence ranging from .94 to .27 for lowest and highest doses. The CPZ equivalent daily oral doses occupying 50 and 100% of the neuroleptic sites were found to be respectively about 6 and 60 μmol/kg. The results establish that washout of neuroleptics from striatal binding sites is a rapid process that strongly suggest that the long-lasting remissions of psychotic patients following neuroleptic withdrawal are not due to persistent dopamine receptor occupation.

16142 **(CONF-8602146—Exc.) Pediatric nuclear medicine.** (American Coll. of Nuclear Physicians, Washington, DC). 1986. Contract FG05-86ER60403. 34p. NTIS, PC A03. Order Number DE87014167/JAW.

From American College of Nuclear Physicians annual meeting; West Palm Beach, FL, USA (26 Feb 1986).

This symposium presented the latest techniques and approaches to the proper medical application of radionuclides in pediatrics. An expert faculty, comprised of specialists in the field of pediatric nuclear medicine, discussed the major indications as well as the advantages and potential hazards of nuclear medicine procedures compared to other diagnostic modalities. In recent years, newer radiopharmaceuticals labeled with technetium-99m and other short-lived radionuclides with relatively favorable radiation characteristics have permitted a variety of diagnostic studies that are very useful clinically and carry a substantially lower radiation burden then many comparable X-ray studies. This new battery of nuclear medicine procedures is now widely available for diagnosis and management of pediatric patients. Many recent research studies in children have yielded data concerning the efficacy of these procedures, and current recommendations will be presented by those involved in conducting such studies. Individual papers are processed separately for the Energy Data Base.

16143 **(DOE/ER—0360) Summary results of an assessment of research projects in the Nuclear Medicine Research program.** (USDOE Office of Energy Research, Washington, DC. Office of Program Analysis). Jan 1988. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005235/JAW.

In May 1987, OHER management requested the Office of Program Analysis (OPA) to conduct a peer review of the projects of the DOE Nuclear Medicine Research program. This was done using procedures and a quantitative methodology OPA developed for assessing DOE research programs. Sixty-three individual nuclear medicine projects were reviewed by seven panels; one panel on isotopes and radioisotopes, three on radiopharmacology, two on clinical feasibility, and one on instrumentation. Each panel consisted of five to ten knowledgeable reviewers. 5 figs.

16144 **(DOE/ER/60175—T2) The development of new bifunctional chelates for imaging: Final progress report for period 1 September 1983 to 31 August 1987.** Hnatowich, D.J. (Massachusetts Univ., Worcester (USA). Medical School). Sep 1987. Contract AC02-83ER60175. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002353/JAW.

The primary object of research performed in this laboratory with support from the DOE has been the development of new ligands for the stable chelation of technetium-99m (/sup 99m/Tc). These chelators are intended first to be used to facilitate the labeling of proteins with this radionuclide and secondly as a means of attaching /sup 99m/Tc to biologically significant molecules of interest. With regard to protein labeling, this laboratory had earlier investigated the chelator diethylenetriaminepentaacetic acid (DTPA) for this purpose and eventually concluded that whereas DTPA is suitable for use with other radionuclides such as ^{111}In, when used to bind /sup 99m/Tc, instability is apparent to a degree which may render the labeling unsuitable. Since our efforts in this direction, a number of other chelators have been tried in other laboratories as means of labeling proteins with /sup 99m/Tc. The only ligand which has thus far been described in detail is p-carboxyethylpenylglyoxal-di(N-methylthiosemicarbazone), or CE-DTS developed by investigators at Kyoto University in Japan. This chelator appears to possess many of the essential properties required for this application, although its use in patients has thus far not been described. 11 refs., 1 fig.

16145 (IAEA-TECDOC—435, pp 117-127) **Survey of immunoassay techniques for biological analysis.** Burtis, C.A. (Oak Ridge National Lab., TN, USA). Oct 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88701294/JAW. (CONF-8610149—).

From Advisory group meeting on comparison of nuclear analytical methods with competitive methods; Oak Ridge, TN, USA (3 Oct 1986).

Immunoassay is a very specific, sensitive, and widely applicable analytical technique. Recent advances in genetic engineering have led to the development of monoclonal antibodies which further improves the specificity of immunoassays. Originally, radioisotopes were used to label the antigens and antibodies used in immunoassays. However, in the last decade, numerous types of immunoassays have been developed which utilize enzymes and fluorescent

dyes as labels. Given the technical, safety, health, and disposal problems associated with using radioisotopes, immunoassays that utilize the enzyme and fluorescent labels are rapidly replacing those using radioisotope labels. These newer techniques are as sensitive, are easily automated, have stable reagents, and do not have a disposal problem. (author). 6 refs, 1 fig., 2 tabs.

16146 (INIS-BR—748, pp 171) **Images by NMR using stimulated hahn echos.** Beckmann, N.; Bonagamba, T.J.; Tannus, A.; Panepucci, H.C.; Neto, A.T.; Martins, M.J. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16147 (INIS-BR—748, pp 171) **Analysis of non-linear effects in the selection of tomagraphy planes by nuclear magnetic resonance.** Bonagamba, T.J.; Beckmann, N.; Tannus, A.; Panepucci, H.C.; Magon, C.J. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16148 (INIS-BR—748, pp 172) **Tomography by NMR: project of a 2.0 Tesla machine.** Tannus, A.; Martins, M.J.; Neto, A.T.; Bonagamba, T.J.; Beckmann, N.; Panepucci, H.C. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16149 (INIS-BR—910, pp 99) **/sup 31/P NMR study of phosphate metabolites in human muscle and blood.** Graggelli, E.; Pogliani, L.; Sabatini, G.; Paolini, E.; Federico, A. (Siena Univ., Italy. Dipt. di Chimica; Siena Univ., Italy. Dipt. di Neurologia). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16150 (INIS-BR—910, pp 99) **/sup 31/P NMR spectroscopy in subjects susceptible of malignant (MH) or exercise (EH) hyperthermia.** Kozak-Reiss, G.; Gascard, J.P.; Durand, J.; Jehenson, P.; Syrota, A.; Tran Dinh, S. (CCML-UA 1159- Le Plessis-Robinson; Sve Hosp. Frederic Joliot - CEA- CH Orsay, France). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16151 (INIS-BR—910, pp 100) **Metal NMR studies of lithium transport in human erythrocytes.** Espanol, M.C.; Ramasamy, R.; Freitas, D.M. de. (Loyola Univ., Chicago, IL, USA. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16152 (INIS-BR—910, pp 1) **Developments in NMR imaging.** Andrew, E.R.; Fitzsimmons, J.R. (Florida Univ., Gainesville, USA. Dept. of Radiology). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16153 (INIS-BR—910, pp 9) **Microscopic NMR imaging.** Lauterbur, P.C.; Hedges, L.K. (Illinois Univ., Urbana, USA. Coll. of Medicine; National Institutes of Health, Bethesda, MD, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16154 (INIS-BR—910, pp 10) **NMR imaging new strategies: magic angle imaging.** De Luca, F.; De Simone, B.C.; Maraviglia, B.; Nuccetelli, C. (Rome Univ., Italy). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16155 (INIS-BR—910, pp 14) **Multiple-pulse sequences for solids - new tools for new tasks.** Weitekamp, D.P. (California Inst. of Tech., Pasadena, USA. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16156 (INIS-BR—910, pp 25) **Noninvasive analysis of bone mineral content.** Brown, C.E. (Medical Coll. of Wisconsin, Milwaukee, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16157 (INIS-BR—910, pp 29) **NMR J imaging.** Manassen, Y.; Navon, G. (Tel Aviv Univ., Israel. School of Chemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16158 (INIS-BR—910, pp 30) **NMR evaluation of temporo-mandibular joint disfunction: strategies involing optimized receiver coil geometries.** Olson, D.; Morrison, K.; Porter, B.; Williams, D.; Gangarosa, R.; Stimac, G.; McNabb, D. (Washington Univ., Seattle, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16159 (INIS-BR—910, pp 57) **Precision mapping of the B/sub 1/ field using the rotating frame experiment.** Murphy-Boesch, J.; So, G.S.; James, T.L. (California Univ., San Francisco, USA. Dept. of Radiology). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16160 (INIS-BR—910, pp 58) **NMR imaging employing Hahn's and stimulated echoes.** Beckmann, N.; Bonagamba, T.J.; Tannus, A.; Panepucci, H.C. (Sao Paulo Univ., Sao Carlos, SP, Brazil. Inst. de Fisica e Quimica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16161 (INIS-BR—910, pp 28) **/sup 31/P-NMR comparative study of muscle enzymep deficiencies.** Jehenson, P.; Duboc, D.; Fardeau, M.; Syrota, A.; Tran Dinh, S. 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16162 (INIS-BR—910, pp 101) **Selective modification of T/sub 1/ relaxation time in human colorectal carcinoma using gadolinium DTPA coupled with monoclonal antibody as NMR contrast agent.** Curtet, C.; Tellier, C.; Bohy, J.; Saccavini, J.C. (Institut National de La Sante et de la Recherche Medicale, INSERM, France; RMN et Reactivite Chimique, UER Sciences, Nantes, France; ORIS-Industrie, Gif-sur-Yvette, France). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16163 (INIS-BR—910, pp 18) **Applicatons of in vivo NMR to cancer.** Li, S.J.; Rajan, S.; Wehrle, J.P.; Sarkar, S.; Janes, N.; Schoeniger, J.; Blackband, S.; Aguayo, J.B.; Glickson, J.D. (Johns Hopkins Univ., Baltimore, MD, USA. Dept. of Radiology). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16164 (INIS-mf—10795, pp 17) **Preclinical studies of the effect of cis-platinum derivatives with estrophilic ligands on hormone-dependent tumors.** Trebert Haeberlin, S.; Lux, F.; Spruss, T.; Gust, R.; Schoenenberger, H. (Technische Univ. Muenchen, Garching, Germany, F.R. Inst. fuer Radiochemie; Regensburg Univ., Germany, F.R. Lehrstuhl fuer Pharmazeutische Chemie 2). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

16165 (INIS-mf—11006) **Computed tomography of the petrous bone in otosclerosis and Meniere's disease.** Groot, J.A.M. de. (Rijksuniversiteit Utrecht (Netherlands)). 14 Apr 1987. 153p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700213/JAW.

The aim of this investigation was to examine if, in the case of otosclerosis and Meniere's disease, one could obtain more information with high resolution computer tomography than with conventional polytomography. In the first part of this thesis a brief survey of some principles of computer tomography is given and a computer tomographic atlas of the normal petrous bone in the otoradiologic planes used in this study. In the introduction of the second part some aspects of otosclerose are discussed (definition, clinical aspects). Subsequently a treatment is given of a part of the histopathology referring to the otospongiotic and otosclerotic changes in the labyrinthine capsule. A survey is given of preceding studies on the petrous bone in the case of otosclerosis; in these studies mostly classical planigraphic techniques were employed. In the third part some general aspects of Meniere's disease are discussed: definition, incidence, clinical aspects and pathophysiology. It is assumed that the symptoms of Meniere's disease are caused by an overpressure in the endolymphatic areas of the labyrinthum (hydrops), however till now a proof for this is still not given. The ductus endolympathicus, which passes through a channel in the petrous bone (the vestibular aqueduct), plays a role in the drainage of endolymph. Stagnation of this drainage could cause hydrops. 137 references, 60 figures, 45 tables.

16166 (INIS-mf—11012) **Contrast media for radiological examination in gastrointestinal tract leakage. An experimental and clinical study.** Ginai-Karamat, A.Z. (Erasmus Univ., Rotterdam (Netherlands)). 15 Apr 1987. 88p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700219/JAW.

The aim of this investigation has been to find a safe and suitable contrast medium (CM) for radiological evaluation of the gastrointestinal tract (GIT) in cases where leakage outside the GIT can be suspected. An experimental study was carried out to evaluate the reactions of various available CM in the bronchi and lungs, mediastinum, pleura and peritoneum of rats. The CM evaluated in the experimental study were, pure barium sulphate (without any additives), commercial barium sulphate (Micropaque, with additives), Dioncail, Hytrast, Gastrografin, Amipaque (in pleura Omnipaque) and Hexabrix.

16167 (INIS-mf—11016) **Three-dimensional teletherapy treatment planning. The technique, an analysis of the quantitative use of Computed Tomography, and models for dose computation of clinical photon- and electron beams.** Panthaleon van Eck, R.B. van. (Technische Univ. Eindhoven (Netherlands)). 11 Nov 1986. 301p. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88700223/JAW.

This thesis deals with physical/mathematical backgrounds of computerized teletherapy treatment planning. The subjects discussed in this thesis can be subdivided into three main categories: a) Three-dimensional treatment planning. A method is evaluated which can be used for the purpose of simulation and optimization of dose distributions in three dimensions. b) The use of Computed Tomography. The use of patient information obtained from Computed Tomography for the purpose of dose computations is evaluated. c) Dose computational models for photon- and electron beams. Models are evaluated which provide information regarding the way in which the radiation dose is distributed in the patient (viz. is absorbed and/or dispersed). 86 references, 85 figures, 9 tables.

16168 (INIS-mf—11017) **Combined therapy for non-resectable squamous cell carcinoma of the oral cavity. Local selective intra-arterial infusion with Adriamycin and Bleomycin combined concurrently with radiotherapy. The predictive value of flow cytometry in monitoring cell cycle kinetic effects of therapy.** Noorman van der Dussen, M.F. (Rijksuniversiteit Utrecht (Netherlands)). 30 Sep 1986. 268p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88700224/JAW.

A promising way to acquire information about individual tumor behavior seems to be the determination of cell kinetic properties and, even more importantly, the changes they undergo during treatment. Ideally, knowledge of changes in cell cycle at all times is desirable so that optimal regulation of the chosen chemotherapy and/or radiotherapy could lead to maximal cell death of the tumor cells with minimal toxicity for the host cells. A possible gain for increasing insight into the characteristics of a particular tumor is DNA flow cytometry. By taking multiple biopsies before and during the chemotherapy/radiotherapy treatment, it is perhaps possible to predict the expected clinical results. Research relating to this is described in this dissertation: 16 patients with non-resectable tumors of the oral cavity were treated with concurrent intra-arterial chemotherapy and radiotherapy. Multiple biopsies were analyzed with DNA flow cytometry and an attempt was made to correlate the clinical response with the acquired cellular kinetic data. The purpose of the research can be summarized as: 1. Is regional cure of non-resectable squamous cell carcinomas possible using the method described? 2. Is it possible, using DNA flow cytometry, to predict the chance of successful therapy? 372 references, 38 figures, 33 tables.

16169 (INIS-mf—11019) **Periodontal bone lesions. An experimental study of interdental bone changes.** Linden, L.W.J. van der. (Vrije Univ., Amsterdam (Netherlands)). 28 Nov 1985. 156p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700226/JAW.

In the course of life the periodontum is subject to changes which may be physiological or pathological. Intraoral radiographs give insight into the hard structures of the dentomaxillar region and provides information on lesions in the bone of the periodontum in that they show radiopacities and radiolucencies caused by such lesions. In this thesis the relation is investigated between the true shape and dimensions of periodontal bone lesions and their radiographic images. A method is developed and tested of making standardized and reproducible radiographs suitable for longitudinal studies of periodontal lesions. Also the possibility is demonstrated of an objective and reproducible interpretation of radiographic character-

istics of periodontal bone lesions. 166 references, 98 figures, 39 tables.

16170 **(INIS-mf—11022) Electron beams in radiation therapy. Collimation, dosimetry and treatment planning.** Bruinvis, I.A.D. (Amsterdam Univ. (Netherlands)). 18 Mar 1987. 141p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700229/JAW.

Clinical electron beams in interaction with beam flattening and collimating devices are studied, in order to obtain the means for adequate electron therapy. A treatment planning method for arbitrary field shapes is developed that takes the properties of the collimated electron beams into account. An electron multiple-scattering model is extended to incorporate a model for the loss of electrons with depth, in order to improve electron beam dose planning. A study of ionization measurements in two different phantom materials yields correction factors for electron beam dosimetry. 182 references, 33 figures, 7 tables.

16171 **(LA-UR—87-3924) Knowledge engineering software: A demonstration of a high end tool.** Salzman, G.C.; Krall, R.B.; Marinuzzi, J.G. (Los Alamos National Lab., NM (USA); Digital Equipment Corp., Los Alamos, NM (USA)). 1987. Contract W-7405-ENG-36. 25p. (CONF-880333—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003159/JAW.

From Analytical and quantitative cytology; Chicago, IL, USA (14 Mar 1988).

Many investigators wanting to apply knowledge-based systems (KBS) as consultants for cancer diagnosis have turned to tools running on personal computers. While some of these tools serve well for small tasks, they lack the power available with the high end KBS tools such as KEE (Knowledge Engineering Environment) and ART (Automated Reasoning Tool). These tools were originally developed on Lisp machines and have the full functionality of the Lisp language as well as many additional features. They provide a rich and highly productive environment for the software developer. To illustrate the capability of one of these high end tools we have converted a table showing the classification of benign soft tissue tumors into a KEE knowledge base. We have used the tools available in Kee to identify the tumor type for a hypothetical patient. 10 figs.

16172 **(PB—88-854435/XAB) Biomedical radiography: radiation protection and safety. January 1970-December 1987 (citations from the NTIS data base). Report for January 1970-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 73p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the safety of biomedical radiography. Radiation-protection methods and techniques are described, and safety techniques for specific radiology procedures are detailed. Radiation exposure of health workers and patients is discussed. Safety limits are defined. (Contains 166 citations fully indexed and including a title list.)

16173 **(SAAS—350) Radiation protection type testing and licensing of diagnostic X-ray equipment in the GDR.** Taschner, P.; Poulheim, K.F.; Feldheim, W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1987. 22p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700940/JAW.

The results of more than 10 years experience in type testing and type licensing of diagnostic X-ray equipment with respect to meeting radiation protection requirements as well as the implications for the conduct of these procedures resulting from the introduction of new radiation protection legislation in 1983 and 1984, are described. At present an updated version of the 'Regulation of 16 December 1977 concerning radiation protection type testing and licensing of sealed radiation sources and equipment emitting ionizing radiation' is being prepared.

16174 (SAAS—351, pp 15-23) **Studies on the pulmonary and bone marrow tolerance in single-dose irradiation with a view to improving the protection of the patient in radiation therapy.** Eichhorn, H.J.; Huettner, J. (Akademie der Wissenschaften der DDR, Berlin. Robert-Roessle-Klinik; Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Krebsforschung). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88780041/JAW.

In Report of the National Board of Nuclear Safety and Radiation Protection of the GDR.

In patients with small-cell bronchial carcinoma who were treated with single-dose irradiation to the upper half-body, the incidence of pneumonitis could be lowered to less than 5% by delivering the total dose of 8 Gy in two fractions of respectively 6 Gy and 2 Gy and separating them by a time intervall of 5 hours. This corresponds nearly with a 20 per cent increase in the tolerance dose to the lungs to 9.6 Gy. A twenty per cent increase in the total dose by administering additional small fractions led to a renewed increase in pneumonitis frequency but only to about half the value observed in single-dose irradiation with 8.8 Gy. Delivering the radiation dose in two portions separated by 5 h also produced a sparing effect for the bone marrow (as measured by lymphocyte numbers) but, in contrast to the lungs, additional small doses caused a level of damage exceeding that due to single-dose irradiation.

16175 **(SAAS—352) Quality assurance in radiation therapy for ensuring the radiation protection of the patient.** Arndt, D.; Eichhorn, H.J.; Herrmann, T.; Voigtmann, L.; Kriester, A.; Salewski, D.; Schmidt, W.; Tode, D. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1987. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700941/JAW.

This issue contains (1) the full text of two pieces of legislation covering the legal requirements for the execution of radiotherapeutic treatments, which came into effect in March 1986; (2) specimen programmes meant to provide guidance on the legally required establishment of test programmes for the routine inspection of radiotherapy equipment in order to demonstrate that it will perform satisfactorily in service; and (3) five papers that have been presented at a workshop organized by 'Gesellschaft fuer Medizinische Radiologie der DDR', held in Bansin, 16-18 May 1985. They deal with the usefulness of the NSD concept in clinical practice including some recommendations aimed to standardize its handling.

16176 **(SAND—87-1532C) Low-density microcellular polymer foams: Applications in biomaterials.** Sylwester, A.; Aubert, J.; Rand, P. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-871124—40). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003256/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Microcellular polymer foams are of interest as biomaterials for uses such as artificial skin, synthetic vascular replacements, artificial organs, and for use in permeable drug delivery systems. This report describes the use of thermally induced phase separation as a technology by which a variety of polymer foams can be prepared. This process permits control of foam morphology, cell size, and density. The phase separation process results in fully open-celled foam structures. Additives such as small molecules and functionalized polymers have been incorporated into these microcellular foams resulting in polymer surfaces with controlled porosity and chemical modification. Microcellular polyurethane foams, with chemically modified surfaces, have potential application as small diameter vascular replacements. 6 refs., 3 figs.

16177 **(TRI-PP—87-76) Conceptual design of a whole body PET [Positron Emission Tomography] machine.** Rogers, J.G.; Harrop, R.; Kinahan, P.E.; Wilkinson, N.A.; Coombes, G.H.; Doherty, P.W.; Saylor, D.P. (TRIUMF, Vancouver, British Columbia (Canada); Tracergraphics, Inc., Westboro, MA (USA)). Oct 1987. 5p. (CONF-871006—38). NTIS (US Sales Only), PC A02. Order Number DE88900280/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

We are designing a whole body Positron Emission Tomography (PET) machine based on a new type of large area sodium iodide (NaI) detector. As pointed out in earlier publications, a tomograph based on these new detectors can have several advantages over conventional PET machines, which are based on small Bismuth Germanate (BGO) detectors. Monte Carlo computer simulations have been used to compare some of the performance parameters of a tomograph based on the new detectors to similar parameters of conventional small crystal machines. Three different variants of prototype detectors have been constructed and many tests performed, including measurements of transverse spatial resolution, depth-of-interaction resolution, energy resolution, time resolution, and high counting-rate capabilities. 7 refs., 10 figs., 1 tab.

16178 **(WHO-RAD—86/1) Guidelines for the installation of WHO Basic Radiological Systems (BRS).** (World Health Organization, Geneva (Switzerland)). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700751/JAW.

The paper gives the specification of space and the design of the rooms required for an X-ray department in a hospital. A minimum of three rooms are required: examination room (X-ray room), darkroom and office/viewing room. The total area of the examination room including the control area should be at least 18 m/sup 2/ . The darkroom should be at least 5 m/sup 2/ for manual processing, and no dimension of the room should be smaller than 2 m. The office/viewing room should be at least 8 m/sup 2/. 4 figs.

16179 **Effect of procainamide, lidocaine and diphenylhydantoin on thallium-201 chloride uptake.** Schachner, E.R.; Oster, Z.H.; Sacker, D.F.; Som, P.; Atkins, H.L. (Brookhaven National Lab., Upton, NY, USA; State Univ. of New York, Stony Brook, USA). *Nuclear Medicine and Biology;* **14**: No. 5, 497-498(1987). Contract AC02-76CH00016.

The effect of procainamide, lidocaine and diphenylhydantoin on the organ distribution (particularly the heart) of /sup 201/Tl chloride in rats was studied. The results show that diphenylhydantoin significantly decreases the uptake of /sup 201/Tl chloride in several organs of rats previously treated with this drug. No statistically significant effects were noted with procainamide and lidocaine.

5507 Microbiology

REFER ALSO TO CITATION(S) 13921, 14254, 14422

5509 Pathology

REFER ALSO TO CITATION(S) 16139, 16171

16180 (INIS-BR—910, pp 18) **Magnetic resonance studies of the pathophysiology of murine malaria.** Smith, I.C.P.; Deslauriers, R. (National Research Council of Canada, Ottawa, Ontario. Div. of Biological Sciences). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16181 **(PB—88-855168/XAB) Toxicity of aromatic polycyclic hydrocarbons. January 1978-December 1987 (citations from the Life Sciences Collection data base). Report for January 1978-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 181p. NTIS PC N01/MF N01.

Supersedes PB—87-850582.

This bibliography contains citations concerning the toxicity and biochemical effects of aromatic polycyclic hydrocarbons. Topics include effects on metabolism and liver activity, cellular responses, binding characteristics, and the occurrence and path of the compounds in food chains. Bioaccumulation studies in specific areas, and isolation and detection techniques are also considered. (This updated bibliography contains 360 citations, 82 of which are new entries to the previous edition.)

5510 Physiological Systems

REFER ALSO TO CITATION(S) 16266

16182 **Kinetics of response of foliar gas exchange to exogenously applied ethylene.** Taylor, G.E. Jr.; Gunderson, C.A. (Oak Ridge National Lab., TN). *Plant Physiology, Supplement;* **83**: No. 4, 99(Apr 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

While the sensitivity of foliar gas exchange to ethylene in some species is documented, the kinetics of response, including reaction rates, effective concentrations, and mode of action, are not well characterized. The responses of carbon dioxide assimilation and stomatal conductance were investigated in Glycine max grown in a controlled environment and exposed to a range of exogenously applied ethylene concentrations. The gas-exchange responses exhibited first-order kinetics at low concentrations (less than 20 μmoles per cubic meter) but zero-order kinetics at all higher concentrations. In the region of first-order kinetics, the rate of inhibition per unit change is ethylene concentration was twice as great for stomatal conductance as for carbon dioxide assimilation. The ethylene concentrations resulting in one-half maximal inhibition of stomatal conductance and carbon dioxide assimilation were 7.4 and 15.6 μmoles per cubic meter, respectively. The ethylene influence on foliar gas exchange exhibited features of capacity-limited or saturation kinetics.

16183 **Membranes, metabolism, and dry organisms.** Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). 370p. (CONF-8510459—). Cornell University Press, 124 Roberts Place, Ithaca, NY 14850. Order Number TI87013408/JAW. Contract FG02-85ER13428.

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

Our understanding of the ways in which desiccated organisms are protected from destruction by reactions in the dry state is in an early state of development. In this volume, contributions to each of these pathways of research are reported. The wide range of experimental and theoretical approaches, from biological to physicochemical, covers an exciting spectrum, from natural history to reductionist experimentation, and blends physiological, chemical, and physical methods in the pursuit of an understanding of anhydrous biology. Each individual report in this volume is separately abstracted and indexed for the Energy Data Base.

5520 Public Health

REFER ALSO TO CITATION(S) 16005, 16012

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 14388, 14412, 15404, 16053, 16145, 16451, 16452, 16453, 16454, 16455

16184 (INIS-BR—748, pp 42) **X-ray scattering by hemeproteins in solution.** Souza, C.F. de; Torrianni, I.L. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16185 (INIS-BR—748, pp 170) **Measurements of transversal and longitudinal relaxation time of rat liver tissues with iron overdose.** Baffa, O.; Tannus, A.; Panepucci, H.C. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16186 (INIS-BR—910, pp 97) **Estimation of drought tolerance of crop plants by NMR.** Tiwari, P.N.; Gambhir, P.N.; Nath, K.K.; Chahal, S.S. (Indian Agricultural Research Inst., New Delhi. Nuclear Research Lab.). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16187 (INIS-BR—910, pp 97) **Determination of oil and sugar content of germinating oilseeds by carbon-13 NMR.** Colnago, L.A.; Seidl, P.R. (Instituto Militar de Engenharia, Rio de Janeiro, Brazil). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16188 (INIS-BR—910, pp 28) **NMR spectroscopy study of trypanosoma Lewisi.** Conti, F.; Delfini, M.; Miccheli, A.; Di Coco, M.E.; Ravagnan, G.P.; Manganaro, M.; Luparini, M.R.; Calio, F. (Universita La Sapienza, Rome, Italy Dipt. di Chimica; Clinica Malattie Tropicali e Infettive, Rome, Italy). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16189 (INIS-mf—11039, pp 25-38) **Review of potential usage of ionising energy treatments for insect disinfestation of fruit, vegetables and other commodities in Queensland.** Heather, N.W. 1985. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700433/JAW.

In Potential use of ionising energy treatment in Queensland's horticultural industries.

Insect species for which disinfestation treatments are required in Queensland are listed. the types of produce they may infest, the sources of ionising energy appropriate for treatment and the doses needed to meet market requirements are examined. The stage of development of ionising energy disinfestation treatments likely to be needed for Queensland's export requirements and research priorities are also discussed.

16190 (INIS-mf—11039, pp 39-45) **Potential use of ionising energy for postharvest disease control.** Muirhead, I.F. 1985. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700433/JAW.

In Potential use of ionising energy treatment in Queensland's horticultural industries.

Doses required for disease control are nearly always in the range which causes host damage. Prospects for effective postharvest disease control by ionising energy treatments alone are therefore severely limited. Doses selected for semi-commercial testing should be those required to achieve insect disinfestation without host damage. Fungicides should be avoided to exploit the commercial advantage of a no-residue ionising energy treatment.

16191 (INIS-mf—11039, pp 46-51) **Postharvest physiological aspects of ionising energy treatment.** Brown, B.I. 1985. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700433/JAW.

In Potential use of ionising energy treatment in Queensland's horticultural industries.

Tropical and subtropical fruits are difficult products to manage because of variation in crop maturity and quality at harvest, susceptibility to preharvest insect infestation, postharvest bruising and disease, and they have a short postharvest shelf life. The effect of ionising energy on the marketable quality of fresh produce includes not only longer physical survival of the produce but also the appearance, aroma, flavour and texture of the produce, right up to final consumption. Only a few fruits and vegetables appear to show potential for the practical application of irradiation as a protective technology.

16192 (INIS-mf—11039, pp 52-67) **Export market potential for selected horticultural crops.** Sheehy, P.T. 1985. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700433/JAW.

In Potential use of ionising energy treatment in Queensland's horticultural industries.

This paper examines the feasibility of utilising an irradiation plant to disinfest fresh fruit and vegetables destined for export markets. It examines the export market potential of selected crops with the prime view of estimating likely trends in export markets in the future. These trends will have a significant bearing on throughput levels, and hence on the economic viability of an ionising energy plant.

16193 (INIS-mf—11039, pp 68-76) **Economic feasibility of using an ionising energy treatment plant for disinfestation of fruit and vegetables in Queensland.** Hassall, R.N. 1985. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700433/JAW.

In Potential use of ionising energy treatment in Queensland's horticultural industries.

A working group has been formed by the Department of Primary Industries to investigate the feasibility of the establishment of a pilot irradiation plant primarily for fresh fruit disinfestation purposes in Queensland. This paper considers the economic feasibility of using ionising energy treatment for disinfestation of fruit and vegetables in Queensland.

16194 (INIS-mf—11039, pp 77-80) **Scope of designs and operation of ionising radiation facilities.** Heather, N.W. 1985. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700433/JAW.

In Potential use of ionising energy treatment in Queensland's horticultural industries.

Cobalt 60 source radiation processing facilities are examined for suitability for commercial irradiation of food. Source pass mechanisms - tote box systems and carier systems are discussed. Blockhouse construction, site requirements and costs are also considered.

16195 (PNL-SA—15112) **An economic analysis of a multi-commodity fruit and vegetable irradiator.** Brown, M.D.; Eakin, D.E.; Young, J.K.; Tingey, G.L. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 26p. (CONF-870822—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003425/JAW.

From American Institute of Chemical Engineers summer national meeting; Minneapolis, MN, USA (16 Aug 1987).

Although irradiation of foods has been studied since the late 1940's and irradiation of grains and potatoes has been approved for years, only recently has the Food and Drug Administration approved irradiation of pork, fresh fruits and vegetables at doses up to 100 krad for commercial sale. A key element in commercializing irradiation technology by the food processing industry is economic viability. This paper presents an economic analysis for a multi-commodity fruit and vegetable irradiator processing apples, cherries, pears, asparagus, onions, and potatoes. Dose, throughput, and the schedule were examined. Design information and capital and operating costs for various sizes of irradiators are presented. The economics look promising, with typical costs in larger facilities in the range of a few cents per pound of product. 12 refs., 7 tabs.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

REFER ALSO TO CITATION(S) 17189

5601 Radiation Effects

REFER ALSO TO CITATION(S) 15498, 16105, 16128

16196 (BMU—1987-166) Biological indicators of radiation exposure - increase of blood serum amylase following irradiation of salivary glands. Hofmann, R.; Pufal, D.; Boegl, W.; Willich, N.; Westhaus, R. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). 1987. 83p. (In German). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

In this paper, an isoenzyme test is described which enables the proteins of pancreas to be differentiated from those of the salivary glands. This isoenzyme test, in combination with an antibody lipase test which in turn is sensitive to the pancreatic enzyme triacylglycerinlipase, has been used to examine a total of the 42 patients under radiation therapy. 25 of these patients had been subjected to partial body exposure of the head region and 17 to whole body exposure. The results show that the amount of activity increase depends upon the dose to the salivary glands and that almost exclusively the isoenzymes of these organs are responsible for the radiation-induced activity increase in the serum. The isoenzyme test proved to be a good approach in cases where pathogenic variations in the serum α-amylase activity concerning primarily the pancreatic glands had to be differentiated from radiation-induced variations.

16197 (CEA-R—5395) Plasmatic and thermographic consequences of local acute irradiation; a qualitative and quantitative analysis in the pig. Lefaix, J.L.; Daduron, F.; Crechet, F.; Tricaud, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Apr 1987. 50p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751571/JAW.

Acute phase reactant proteins associated with thermographic measurements and enzymatic activity assays in plasma were carried out on 39 pigs, following local exposure of the thigh to a collimated source of iridium 192 at doses ranging between 30 and 84 Gy (2 cm depth dose). The inflammatory response after irradiation, from day 1 to day 30 was accompanied by plasma protein changes associated with an elevation of local and general temperatures in irradiated animals. Degenerative processes in muscle led to an increase of plasmatic creatine kinase and lactate-dehydrogenase. Results were developed qualitatively (distribution pattern of proteins, thermographic measurements, enzymatic activities and clinical evolution of the lesions) and qualitatively (plasma level of creatine kinase versus applied radiation doses and pharmalogical treatments).

16198 (CONF-861044—10) The biophysical stage of radiation carcinogenesis. Rossi, H.H.; Zaider, M. (Columbia Univ., New York (USA). Dept. of Radiation Oncology). 1986. Contract FG02-86ER60449. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004758/JAW.

From 25. Hanford Life Sciences symposium: radiation protection-a look to the future - celebrating four decades of research at Hanford; Richland, WA, USA (21 Oct 1986).

The dependence of the induction of cancer on the absorbed dose of ionizing radiations has been specified in terms of increasing complexity. The first notion of the linear hypothesis is now frequently replaced with a dependence on both the first and second powers of the dose the linear-quadratic model, which implies proportionality at low doses only. Microdosimetric considerations and in particular the theory of dual radiation action would be in accord with this relation if tumors were to arise from single cells as the result of a transformation that depends only on the radiation received by the cell. In this case it must be expected that the linear portion of the dose-effect curve is dose rate independent but that the quadratic component may decrease with decreasing dose rate because of repair. However it was shown some time ago that the dose-incidence relation of a neoplasm indicates a non-autonomous response because of departure from a linear dependence when the mean number of events in cells is much less than one in neutron irradiations. Another discrepancy is the repeated observation that reduction of dose rate, while resulting in the expected lessening of the effectiveness of low-LET radiation, increases the effectiveness of neutrons especially in the case of oncogenic cell transformation. 32 refs., 3 figs.

16199 (CONF-8707137—1) Dosimetry of Auger emitters: Physical and phenomenological approaches. Sastry, K.S.R.; Howell, R.W.; Rao, D.V.; Mylavarapu, V.B.; Kassis, A.I.; Adelstein, S.J.; Wright, H.A.; Hamm, R.N.; Turner, J.E. (Massachusetts Univ., Amherst (USA). Dept. of Physics and Astronomy; University of Medicine and Dentistry of New Jersey, Newark (USA). Dept. of Radiology; Harvard Univ., Boston, MA (USA). Shields Warren Radiation Lab.; Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002786/JAW.

From Workshop on aspects of dosimetry of internally incorporation Auger emitters; Harwell, UK (17 Jul 1987).

Recent radiobiological studies have demonstrated that Auger cascades can cause severe biological damage contrary to expectations based on conventional dosimetry. Several determinants govern these effects, including the nature of the Auger electron spectrum; localized energy deposition; cellular geometry; chemical form of the carrier; cellular localization, concentration, and subcellular distribution of the radionuclide. Conventional dosimetry is inadequate in that these considerations are ignored. Our results provide the basis for biophysical approaches toward subcellular dosimetry of Auger emitters in vitro and in vivo. 12 refs., 7 figs., 2 tabs.

16200 (DOE/ER/60409—2) Immunodeficiency syndromes: Disorders of lymphocytopoiesis caused by environmental agents: Annual progress report. Rosse, C. (Washington Univ., Seattle (USA)). [1987]. Contract FG06-86ER60409. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004120/JAW.

These publications and our current research activities focus mainly on questions of lymphocyte production and regulation. Our activities during the past year have been characterized by collaboration and a multi-faceted approach. We have continued our work, which elucidates the modulatory influence of the CE mammry carcinoma (CEmaca) on lymphocytopoiesis and on bone metabolism. We have paid particular attention to natural killer (NK) cells in this experimental system. We developed in vitro techniques that support clonal growth of the tumor and make possible the in vitro maintenance of microenvironments that support long-term lymphocytopoiesis. We have defined NK cell precursors and the modulation of NK cell production. We have identified early T cell progenitors in the fetal thymus and bone marrow and have defined the stromal elements of the thymus with an important role in thymic lymphocytopoiesis. We are beginning our inquiry into the molecular mechanisms that control T cell development at the genomic level. The experimental system for this approach has been a retrovirus-induced murine thymoma. The discovery of a viral enhancer element in this system, which is specific for the T lineage, holds considerable promise for investigating T lymphocyte development. 2 figs., 11 tabs.

16201 (DOE/ER/60417—T1) Fast neutron dosimetry: [Progress report, 1986-1987]. DeLuca, P.M. Jr.; Gould, M.N.; Meisner, L.F.; Pearson, D.W. (Wisconsin Univ., Madison (USA). Dept. of Medical Physics). 1987. Contract FG02-86ER60417. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004194/JAW.

A new research area was initiated in ultrasoft x-rays with the University of Wisconsin 1-GeV electron storage ring used as a radiation source. A new beam line and irradiation apparatus was designed and constructed. Amongst the distinguishing features are an irradiation vessel of considerable generality allowing many types of radiological/biological experiments to be performed; the ability to

maintain low-pressure, high humidity environments with good control; and a computer controlled sample slide for [X,Y,Z] motions of high precision that allows fully controlled velocities and accelerations for complex sample irradiations. Work in the area of chromosomal aberration studies has continued after the completion of the investigation into the possible synergistic effects of mixed beams of neutrons and photons. Of special interest is the damage dependence on absorbed dose and dose rate for low-dose and low-dose rate exposures to high LET radiation. A unique microdosimetric instrument was employed in the continuing effort to measure dose distribution in LET from fast neutron irradiation of metal-metal oxide walls. Our purpose is to determine this distribution for oxygen, an element of critical importance to fast neutron dosimetry. 31 refs., 7 figs., 2 tabs.

16202 **(DOE/ER/60448—02) Comparative mutagenesis in human cells in vitro and in vivo: First progress report for the period 15 July 1986-30 June 1987.** Thilly, W.G. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Applied Biological Science). Jun 1987. Contract FG02-86ER60448. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88001811/JAW.

We used the technique of denaturing gradient electrophoresis to produce a pure mutant sequence so that we were able to directly sequence the mutant without bacterial cloning. As part of our continuing studies of the hprt locus in human cells, we have isolated a series of chemically induced mutant DNA sequences in HPRT exon 3 which had been selected by 6-thioguanine resistance. Using denaturing gradient gels to study the amount and kinds of mutations induced in vitro by certain DNA polymerases, we modified polymerase chain reaction (PCR) DNA amplification to our studies of mutation in the human hprt gene. We studied the nature of T_4 DNA polymerase errors and discovered a means to overcome the principle source of noise in amplifying sequences from the human genome. We initiated studies of multi-copy sequences in the human genome so that mutational spectra may be obtained from small numbers of human cells. We worked out novel statistical modes of analysis for planning and evaluating long term low dose human cell mutation studies, and mutational spectra from cell-based or DNA sequence-based studies. We have characterized the positions of large deletion mutations, confirming 6TG resistance in human cells and have found an intron of hprt which has an apparently high density of deletion endpoints within it. We used exon specific probes to discover which exons are present in each of the four pseudogenes of hprt which are scattered over three human autosomes. 41 refs., 8 figs., 10 tabs.

16203 **(DOE/ER/60525—1) International conference on non-military radiation emergencies: [Final technical report].** (American Medical Association, Chicago, IL). 1986. Contract FG02-87ER60525. 329p. (CONF-8611150—). NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE88003364/JAW.

From International conference on non-military radiation emergencies; Washington, DC, USA (19 Nov 1986).

The subject of this report was limited to non-military radiation emergencies because such events needed to be addressed and the topic was considered to be manageable. The Conference theme developed around the lessons learned from the radiation emergencies at Chernobyl, Three Mile Island, and Windscale. Specific topics to be considered included acute and long-term effects of radiation exposure; frequency and nature of radiation emergencies; national standards for exposures to ionizing radiation; plans and procedures for responding to emergencies at the hospital, community, and national levels; and responsibilities of physicians and other health professionals regarding radiation exposures and emergencies.

16204 **(EFI—915(66)-86) Interpretation of modifying factors effects in terms of oxygen effect.** Atayan, R.R. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700170/JAW.

In radiobiological investigations with dried seeds, it is found out that efficiency of phisical and chemical factors associated with irradiation, is connected with their influence on the extent of oxygen effect. This is shown by direct oxygen control in the experiment for such factors as water content and postradiation storage. Such approach, however, has a limited application. A new approach is proposed - oxygen control through control of water content - which allows to consistently describe in terms of oxygen effect different aspects of interaction of seed water content, postradiation storage and heat-shocks in modification of radiation damage.

16205 **(FNAL-TM—1499) Analysis of exposure due to work on activated components.** Cossairt, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1987. Contract AC02-76CH03000. 9p. (CONF-8710233—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003966/JAW.

From Meeting of the task force on radioactivation at the SSC; Berkeley, CA, USA (1 Oct 1987).

In this brief note the author summarized analysis of the exposure incurred in various maintenance jobs involving activated accelerator and beam line components at Fermilab. A tabulation was made of parameters associated with each job. Included are rather terse descriptions of the various tasks. The author presented various plots of the quantities in the table. All exposure rates are mR/hr while all exposures accumulated are mR. The exposure rates were generally measured at the Fermilab standard one foot distance from the activated component. Accumulated exposures are taken from the self-reading pocket dosimeter records maintained by the radiation control technicians.

16206 (INIS-BR—910, pp 14) **Pr/sup 3+/ transport across phospholipid vesicles in the joint presence of an ionophore and a fatty acid.** Grandjean, J.; Laszlo, P. (Liege Univ., Belgium. Inst. de Chimie). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16207 **(INIS-GB—60) EDRP public local inquiry, UKAEA/BNFL precognition on: Concern about childhood leukaemia in the West of Scotland.** Gillis, C.R.; Hole, D.J. (UKAEA Headquarters, London; British Nuclear Fuels Ltd., Risley). Sep 1986. 5p. (DP—19). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750913/JAW.

Date relating to the West of Scotland Cancer Registry Region, comprising 26 local government districts and containing 4 nuclear installations, are presented. The data relate to children aged 0-14 years.

16208 **(INIS-GB—61) EDRP public local inquiry, UKAEA/BNFL precognition on: Review of the Scottish Health Service ISD report on 'Geographical distribution of leukaemia in young persons in Scotland 1968-1983'.** Wilkie, D. (UKAEA Headquarters, London; British Nuclear Fuels Ltd., Risley). Sep 1986. 26p. (DP—20). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750912/JAW.

The Scottish Health Service ISD Report is reviewed, with particular attention being paid to the statistical treatment of the data and its interpretation in relation to the location and frequency of occurrence of clusters of leukaemia identified in it. The sensitivity of cluster occurrence to the choice of sector boundaries and to the sub-division of the total time period of the study is considered, in general terms and by numerical experiment.

16209 **(INIS-GB—94) Child leukaemia around Sellafield. Local community reaction to the television documentary 'Windscale - the nuclear laundry'.** Berkhout, F.; MacGill, S.M. (Leeds Univ. (UK). School of Geography). Mar 1986. 35p. School of Geography, University of Leeds, Leeds LS2 9JT.

The survey was made four months after the publication of the Black Report and extended over a random sample of 462 people in six Parish Councils constituting the domain of interest of the inquiry resulting from the television programme concerning the

Sellafield Reprocessing Plant; 80% of the sample had seen the programme. (U.K.).

16210 (INIS-mf—10795, pp 19) **Behaviour of orthopaedic tantalum implants studied by activation analysis.** Michel, R.; Reich, M.; Nolte, M.; Rabenseifner, L. (Hannover Univ., Germany, F.R. Zentraleinrichtung fuer Strahlenschutz, ZfS; Koeln Univ., Germany, F.R. Abt. Nuklearchemie; Orthopaedische Klinik Koenig-Ludwig-Haus, Wuerzburg, Germany, F.R.). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751522/JAW. (CONF-8710240—).

From 13. seminar on activation analysis; Koeln, F.R. Germany (5 Oct 1987).

16211 (INIS-mf—11026) **Electron migration in hydrated biopolymers following pulsed irradiation at low temperatures.** Lith, D. van. (Rijksuniversiteit Leiden (Netherlands)). 14 May 1987. 97p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700233/JAW.

Charge migration in biopolymer-water mixtures and the effect of water concentration on the charge migration is investigated by measuring the electrical conductivity and the light emission with the pulse radiolysis technique. A preliminary account of the microwave conductivity observed in hydrated DNA and collagen at low temperature after pulsed irradiation is given. The results show that when hydrated DNA or collagen are irradiated at low temperatures, conductivity transients with microsecond lifetime are observed. It is tentatively concluded that these transients are due to the highly mobile dry electron. The effect of water concentration on mobility, lifetime and migration distance of the electron is discussed. The effect of additives to the hydrated systems on the behavior of the electron is described. It is shown that the observed effects of the additives confirm the earlier conclusions that the dry electron is the species responsible for the radiation induced conductivity. The water concentration in the DNA- and collagen-systems could be varied only between zero and approximately fifty percent, due to inhomogeneities which occur at higher water concentrations. Experiments on gelatin, a biopolymer which forms homogeneous samples with levels of hydration varying from almost zero to 100% water (ice) are described. Both the radiation induced and the dark microwave conductivity have been studied as a function of water content. Preliminary results of a study of the light emission from pulse irradiated DNA-water mixtures are reported in an attempt to establish a relation between the observed electron migration and the formation of excited states via charge neutralization. 121 references, 20 figures, 1 table.

16212 (INIS-mf—11028) **Hormonal protection of spermatogenic stem cells during irradiation. A histological, hormonal and flow cytometric study in rats.** Kroonenburgh, M.J.P.G. van. (Katholieke Univ. Nijmegen (Netherlands)). 16 Oct 1986. 139p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700235/JAW.

In this thesis it is examined if by hormonal suppression of spermatogenesis the disadvantageous side-effects of radiation therapy on the gonads can be reduced. Therefore a rat model was investigated, where hormonal suppression of spermatogenesis during irradiation was achieved and stem cell survival was measured. Attention was focused on the stem cell, because this cell is primarily responsible for the late effects of radiation on fertility. Flow cytometrical and histological techniques were used as parameters for measuring stem cell survival. Serum concentrations of FSH, LH and testosterone were measured to evaluate the hormonal suppression. 385 references, 29 figures.

16213 (NRPB-R—196) **Risks of leukaemia and other cancers in Thurso from radiation exposure.** Dionian, J.; Muirhead, C.R.; Wan, S.L.; Wrixon, A.D. (National Radiological Protection Board, Chilton (UK)). Sep 1986. 37p. H.M. Stationery Office, London, price Pound 5.00.

This report provides estimates of the risks of radiation-induced leukaemia and other fatal cancers to children and young persons in Thurso, Caithness. All principal sources of radiation exposure are considered, i.e. discharges of radionuclides to sea and to atmosphere from operations at Dounreay Nuclear Power Development Establishment (DNPDE), discharges of radionuclides to sea from British Nuclear Fuels plc, Sellafield, fallout from atmospheric testing of nuclear weapons, natural radiation and diagnostic medical procedures. The assessment indicates that in the population of 4550 followed to 1985, only 0.34 leukaemias due to radiation exposure would be expected in children and young persons under 25 years of age. Discharges from DNPDE contributed slightly more than 1% and discharges from BNFL, Sellafield, 0.3% of this risk. Most of the risk, about 80%, resulted from natural radiation. The calculated numbers of other fatal cancers from radiation exposure are also less than one, and again natural radiation contributed most of the risk.

16214 (NRPB-R—197) **Factors affecting skin doses due to radon daughters.** Miles, J.C.H. (National Radiological Protection Board, Chilton (UK)). Aug 1986. 10p. H.M. Stationery Office, London, price Pound 3.00.

Concern has been expressed that work with VDUs could increase skin doses due to alpha particles because the electrostatic fields associated with the VDUs may increase the rate of plate-out of radon daughters on human skin. This concern is misplaced. Measurements have been carried out on the effect of electrostatic fields and other influences on the plate-out of radon daughters. These have shown that although VDUs can affect the rate of plate-out under some circumstances, their effect is minor compared with some other common influences. The major factors determining skin dose are the thickness of the skin, the ambient radon concentration, and electrostatic charges on the person. Inhalation of radon daughters remains the most important mechanism of human exposure and is unaffected by the presence of VDUs.

16215 (ORNL/M—454) **The ORNL whole body counter.** (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004786/JAW.

This report is a non-technical document intended to provide an individual about to undergo a whole-body radiation count with a general understanding of the counting procedure and with the results obtained. 9 figs. (TEM)

16216 (PB—88-142724/XAB) **Collaborative Radiological Health Laboratory annual report 1986: health effects of prenatal and postnatal whole-body exposure to ionizing radiation in the beagle dog.** (Colorado State Univ., Fort Collins (USA). Collaborative Radiological Health Lab.). Aug 1987. 67p. NTIS, PC A04/MF A01.

See also report for 1985, PB—87-109773.

The Collaborative Radiological Health Laboratory was established in 1962 by the U.S. Public Health Service and Colorado State University for the purpose of determining in a carefully controlled animal experiment the life-time hazards associated with prenatal and early postnatal exposure to ionizing radiation. The CRHL study is designed to provide information that will facilitate the evaluation of risks to human beings from medical exposure during early development. This is a long-term (lifespan) study of a moderately large and long-lived mammal exposed at one of several times during development to a relatively small and discrete dose of external radiation. Ages-at-irradiation selected for comparison reflect the primary concern with medical exposures during the development period. The basis experiment under this contract contains 1,680 beagles that will be maintained and evaluated for most of their natural lives. Commitment of animals began in December 1967 and was completed in October 1972. The annual report summarizes the current status of the study for the reporting period of November 21, 1985 through November 20, 1986.

16217 (SAAS—351, pp 5-13) **Radiation protection of the patient during medical uses of ionizing radiation in the GDR.** Arndt, D. 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88780041/JAW.

In Report of the National Board of Nuclear Safety and Radiation Protection of the GDR.

Section 18 of the new Radiation Protection Ordinance of the GDR defines basic principles for the radiation protection of patients undergoing diagnostic examinations or treatments with ionizing radiation, including, for example, the requirements that neces-

sary exposures should be justifiable in terms of the benefit to be expected and that doses administered should be limited to as low an amount as possible. An outline is given of these principles, their importance and enforcement.

16218 **(SAAS—351) Report of the National Board of Nuclear Safety and Radiation Protection of the GDR.** (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1987. vp. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88780041/JAW.

Individual papers contained within the report have been selected for entry into the Energy Data Base.

16219 **(TPRD/B—0897/R87) Radioactivity measurements on live Bewick's Swans.** Hancock, R.; Wollam, P.B. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jan 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750321/JAW.

Measurements made on 46 live swans at Slimbridge using portable high resolution hyperpure germanium gamma ray spectrometry equipment are described. Laboratory measurements are also reported on two swans which died of natural causes or of flying accidents. The implications of the measured radioactivity levels are discussed in relation to the suggestion that they might have been affected by the Chernobyl accident on their migration.

16220 **(UCRL—96934) Dose estimates from the Chernobyl accident.** Lange, R.; Dickerson, M.H.; Gudiksen, P.H. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 27p. (CONF-871101—78). NTIS, PC A03. Order Number DE88004711/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

The Lawrence Livermore National Laboratory Atmospheric Release Advisory Capability (ARAC) responded to the Chernobyl nuclear reactor accident in the Soviet Union by utilizing long-range atmospheric dispersion modeling to estimate the amount of radioactivity released (source term) and the radiation dose distribution due to exposure to the radioactive cloud over Europe and the Northern Hemisphere. In later assessments, after the release of data on the accident by the Soviet Union, the ARAC team used their mesoscale to regional scale model to focus in on the radiation dose distribution within the Soviet Union and the vicinity of the Chernobyl plant. 22 refs., 5 figs., 5 tabs.

16221 **(UCRL—97863) The role of intestinal injury in hematopoietic gamma ray mortality.** Broyles, A.A. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 9p. (CONF-871244—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004357/JAW.

From Conference on protracted exposure to ionizing radiation; Washington, DC, USA (1 Dec 1987).

Leukemia patients typically have low granulocyte counts as do those with aplastic anemia. A review of the literature on these latter patients quickly indicates that they live much longer than leukemic patients with the same counts. To check this numerically, the survival times for 12 aplastic anemia patients reported in 1934 were compared with the expected survival times for more recent patients using methods employed to compute the probabilities. On the average, the aplastic anemia patients lived almost ten times as long as the leukemia patients would have been expected to live. 5 refs., 2 figs.

16222 **(ZfK—594, pp 25-29) Certain patterns of DNA double strand breaks in membrane-attached superstructure units cause cell killing: a radiation action model.** Regel, K. Jul 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780042/JAW.

In Publications from the department of large-scale devices of the Central Institute of Nuclear Research at Rossendorf.

The discovery that the chromosomal DNA is arranged in membrane-attached superstructure units (MASSUs) is the key for the understanding of the action of ionizing radiations on mammalian cells. Concerning X-rays the following hypothesis is proved true: The appearance of K ≧ 2 double-strand breaks (DSBs) in any MASSU of a G/sub 1/ cell, respectively, in both MASSUs of any sister MASSU pair of a S cell results in its inactivation (k = actual number of DSBs per MASSU). DSB patterns in the MASSUs characterized by less DSBs will be repaired by recombination with homologous MASSUs. In G/sub 1/ cells it occurs by the recombination with the homologous MASSU of the homologous chromosome. In the replicated MASSUs of S cells it probably happens by the succession of the following mechanisms: recombination repair of MASSUs with one DSB using the sister MASSU as a matrix (sister chromatid exchange), establishment of 1 intact genome by the substitution of the heavily damaged MASSUs (k ≧ 2) by the intact or repaired sister MASSU at the common attachment point, and degradation of the heavily damaged or abundant MASSUs. Thus the dependence of the form and the steepness of the dose survival curves on the cell cycle stages is interpreted by a universally valid radiation action mechanism.

16223 **(ZfK—594) Publications from the department of large-scale devices of the Central Institute of Nuclear Research at Rossendorf.** Fuelle, R. (ed.). (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jul 1987. vp. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780042/JAW.

Papers within the scope of EDB have been entered individually into the data base. (ACR)

16224 **Bone marrow cells other than stem cells seed the bone marrow after rescue transfusion of fatally irradiated mice.** Cronkite, E.P.; Inoue, T.; Bullis, J.E. (Brookhaven National Lab., Upton, NY). *Experimental Hematology;* **15**: No. 11, 1168-1170(Dec 1987).

In a previous publication, iodinated deoxyuridine (^{125}IUdR) incorporation data were interpreted as indicating that spleen colony-forming units (CFU-S) in DNA synthesis preferentially seeded bone marrow. In the present studies, the CFU-S content of marrow from irradiated, bone-marrow transfused mice was directly determined. Pretreatment of the transfused cells with cytocidal tritiated thymidine resulted in an insignificant diminution in CFU-S content when compared with nontritiated thymidine pretreatment, implying that there is no preferential seeding. The ^{125}IUdR incorporation data have been reinterpreted as being a result of the proliferation of other progenitor cells present that have seeded the bone marrow.

16225 **Forecasting radiation rates and exposure from multi-aged fallout.** Haaland, C.M. (Oak Ridge National Lab., TN). *Health Physics;* **53**: No. 6, 613-622(Dec 1987).

A graphical method for forecasting radiation exposure rates from multi-aged fallout is extended to include a nomogram method. A simple method for forecasting accumulated radiation exposure is also presented. It is shown mathematically that these methods can provide estimates of radiation exposure rates or cumulative exposures for intervals of a few days to a few weeks in the future to within +/- 30% from assumed actual radiation exposure rates or accumulated exposures for fallout that decays according to t-n, where n is any number from 0.8 to 1.6. Because of the self-adjusting feature of the method which results in an estimated effective age for the fallout, it is not necessary to attempt to subtract contributions from separate fallouts with different ages. The method can be applied to composite fallout without knowledge of the previous history of the various-aged contributions.

16226 **Cluster-ion bombardment of biological macromolecules: morphological evidence for disassembly of single tobacco mosaic virus particles.** Ledbetter, M.C.; Beuhler, R.J.; Friedman, L. (Brookhaven National Lab., Upton, NY). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 1, 85-88(Jan 1987). Contract AC02-76CH00016.

Cluster ions containing 50, 100, or 200 water molecules and one proton are accelerated to over 275 kV and impacted on thin carbon films on which tobacco mosaic virus has been dispersed. After bombardment the films are examined with a transmission

electron microscope to study induced morphological alterations with respect to the energy transfer processes that take place during and after single cluster-ion impact. Observations on tobacco mosaic virus indicate that a single cluster impact results in the removal of a cylindrical segment of the virus. No fragments from the excised TMV segment were observed on the carbon foil. The authors speculate that cluster-ion bombardment may become a useful analytical technique for structural studies of large biological macromolecular complexes.

16227 **Test of a repair saturation hypothesis with plateau phase CHO cells.** Braby, L.A.; Metting, N.F.; Nelson, J.M. (Pacific Northwest Lab., Richland, WA 99352). pp 33 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC06-76RL01830.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Several different mechanisms have been proposed as the basis for mathematical models which relate radiation exposure to biological effect. In the case of in vitro irradiation of cell cultures, several types of models can explain the shape of the survival curve and the results of dose rate, split dose, and delayed plating experiments. Slight differences between the models can then be used to test the relevance of specific mechanisms for a given cell system. For example, one frequently used mechanism is the saturation of a repair capacity. Simple saturable repair models such as described by Goodhead predict lower survival in split dose experiments than in delayed plating experiments having a comparable time for repair. The authors have performed these types of experiments on plateau phase CHO cells, and the results are not compatible with this prediction. Possible alternative interpretations are explored.

16228 **Direct effects in DNA, an overview of ESR studies.** Bernhard, W.A. (Dept. of Biophysics, Univ. of Rochester, Rochester, NY 14642). pp 60 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The purpose of this talk is to briefly review current thinking on the mechanisms of radiation damage in nucleic acid constituents as viewed through ESR studies of solid state materials. With this backdrop recent results on polynucleotides and DNA are examined. In order to apply information obtained from DNA constituents to DNA itself, there are three key questions regarding chemical distribution that must be answered. 1. Are initial free radical ions formed exclusively on the bases and thereby not at all on the sugar phosphate backbone? 2. Are the sites of electron gain and electron loss confined to specific bases such as the thymine anion and guanine cation? 3. What conditions are necessary for base centered radicals to attack the sugar phosphate backbone? There are also a number of crucial questions regarding spatial distribution. 1. What are the free radical yields? 2. What is the relative proximity of geminate ions? 3. How important are ionization clusters? Recent work from the authors laboratory, as well as others, will be drawn upon in order to address these questions.

16229 **Origin of the effects of cell cycle age on radiation sensitivity.** Nelson, J.M.; Braby, L.A.; Metting, N.F.; Roesch, W.C. (Pacific Northwest Lab., Richland, WA 99352). pp 35 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC06-76RL01830.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The observed differences in radiation sensitivity as a function of cell age could reflect either differences in cellular capacity to remove different types of damage, or differences in damage production. The authors used centrifugal elutriation methods to produce enriched populations of G/sub 1/-, S-, and G/sub 2/-phase cells from stationary phase CHO cultures. Recognizing the imperfect correlation between cell age and cross-sectional area (the criterion upon which the separation process is based) flow-cytometric methods were used to measure cellular DNA content and determine cell age distributions. Split-dose repair kinetics were then determined for cells in different phases of the cycle. The authors find no striking differences in total repair, indicating that damage is removed at generally the same rate and with essentially the same efficiency, throughout the cell cycle. This suggests that changes in the production of damage are likely responsible for the change in sensitivity.

16230 **Direct effect damage to DNA by energetic electrons.** Holley, W.R.; Magee, J.L.; Chatterjee, A. (Univ. of California, Lawrence Berkeley Lab., Berkeley, CA 94720). pp 33 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

A theoretical study of the induction of DNA strand breaks resulting from the direct deposition of energy on the polynucleotide by energetic electrons is reported. The average energy loss per glancing collision has been taken to be 30 eV, similar to the value for water. A typical energy loss event occurring on the DNA backbone is assumed to lead to ionization and eventually to strand break formation. The G-values for direct production of single and double strand breaks are calculated using a combination of Monte-Carlo techniques incorporating a detailed stereochemical model of the DNA and a simple electron track model for electron energies below 5 keV and an integral equation used previously by Magee and Chatterjee for energies above 5 keV. The authors discuss the relation of these electron results to the contributions of knock-on electrons to direct effect damage to DNA by heavy charged particles.

16231 **Cell killing by ultrasoft x-rays.** Raju, M.R.; Carpenter, S.; Cornforth, M.; Schillaci, M.; Goodhead, M.R.C. (Los Alamos National Lab., Los Alamos, NM). pp 31 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The experimental results of cell killing by ultrasoft x-rays (0.28 and 1.5 keV) is presented. Cell lines V79, 10 T 1/2 and human skin fibroblasts that have different cellular dimensions due to difference in their attachment properties were used in these studies. Cellular dimensions at the time of exposure to ultrasoft x-rays were carefully measured by optical and electron microscopy. The results indicate that the differences in cell killing by ultrasoft x-rays and hard x-rays may be dependent on nuclear configurations of cells. The implications of these results to theories of radiation action are discussed.

16232 **Radiation-induced micronuclei in peripheral erythrocytes of Rana catesbeiana: an aquatic animal model for in vivo genotoxicity studies.** Krauter, P.W.; Anderson, S.L.; Harrison, F.L. (Lawrence Livermore National Lab., CA). *Environmental and Molecular Mutagenesis;* **10**: No. 3, 285-296(1987).

An in vivo micronucleus assay for peripheral erythrocytes of Rana catesbeiana tadpoles was developed and evaluated. The assay was used to determine the spontaneous frequency of micronuclei in circulating erythrocytes in tadpoles from two different populations, to define the time from administering the clastogen to the maximum micronucleus frequency in peripheral erythrocytes, and to determine the response to radiation. The spontaneous frequency of micronuclei in circulating erythrocytes of early-stage tadpoles was low (3.6 +/- 2.8 micronuclei per 1,000 erythrocytes, MN o/oo), but higher than that of late-stage tadpoles (1.7 +/- 0.7 MN o/oo). The time from the exposure of early-stage tadpoles to radiation (2.1 Gy) to the maximum micronucleus frequency was about 2 wk. The increase in frequency of micronuclei in peripheral erythrocytes of late-stage tadpoles receiving doses ranging from 0.5 to 3.0 Gy was linear with dose; a 3-fold increase was obtained with a dose of 3.0 Gy. The spontaneous frequency of micronuclei in erythrocytes and the increase in frequency induced by radiation appeared to differ in tadpoles from different populations. Quantification of micronuclei in the peripheral erythrocytes of R catesbeiana tadpoles provides a

promising whole-animal system for studies of genotoxicity in aquatic environments.

16233 **Recent advances in nanometer energy deposition.** Kliauga, P. (Radiological Research Lab., College of Physicians and Surgeons of Columbia Univ., New York, NY). pp 115 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

A brief survey of radiobiological data which provide evidence for the relative importance of "short range" interactions is presented. This is followed by a summary of recent experimental attempts at measuring ionization distributions in simulated nanometer-sized unit density sites, sometimes called "nanodosimetry." In particular, cloud chamber and SEM methods are reviewed. Finally, progress in methods being developed at the Columbia Radiological Research Laboratory is discussed. Speculation about future paths for nanodosimetry research conclude this discussion.

16234 **Preliminary studies on the spatial-temporal microdistribution of inhaled soluble plutonium in the lungs of dogs.** Cho, M.W.; Dagle, G.E. (Whitman College, Walla Walla, WA). *Proceedings of the Society for Experimental Biology and Medicine;* **185**: No. 2, 238(1987). (CONF-8610350—). Contract AC06-76RL01830.

From Annual meeting of the Northwest Section of the Society for Experimental Biology and Medicine; Cheney, WA, USA (25 Oct 1986).

The pulmonary microdistribution of inhaled soluble plutonium in four beagle dogs was studied in autoradiographs of histologic sections and transmission electron micrographs of lungs. Dogs were exposed to a single nose-only aerosol of ^{239}Pu nitrate with a post-exposure time ranging from 1 month to 42 months. At one month after the exposure, the plutonium was dispersed throughout the lung section, with a higher percentage of the activity found on alveolar macrophages and alveolar septa. However, a nonrandom localization of the plutonium was observed as time passed. The focal concentrations were primarily in nodular or diffuse interstitial fibrotic tissues typically contiguous with subpleural, peribronchial, or perivascular areas. More than 50% of the total activity was in the form of single-tracks at one month exposure, and this percentage increased with time. In summary, this preliminary study suggests an initial random dispersion of soluble plutonium with increased concentration of activity to nonrandom focal locations with time.

16235 **Molecular lesions in oncogenes: a means of determining cancer causation?.** Frazier, M.E.; Stiegler, G.L.; Rausch, R.J.; Scott, L.L.; Peterson, S.R.; Upton, K.E. (Pacific Northwest Lab., Richland, WA). *Proceedings of the Society for Experimental Biology and Medicine;* **185**: No. 2, 237(1987). (CONF-8610350—). Contract AC06-76RL01830.

From Annual meeting of the Northwest Section of the Society for Experimental Biology and Medicine; Cheney, WA, USA (25 Oct 1986).

Although some carcinogens give rise to unique types of cancer, causative agents for most cancers are not identifiable. A long-term goal of the authors research is to devise methods for detecting molecular differences in tumor cells that identify the causative agent. They are using normal and cancer tissues from plutonium-exposed dogs to determine whether radiation causes distinguishable patterns of genetic change. Initial studies provide three lines of evidence that a specific oncogene related to the Kirsten-ras (ki-ras) gene is activated in these tumors: 1) DNA from plutonium-induced lung tumors transformed NIH-3T3 cells in the standard transfection assay; 2) DNA from plutonium-induced lung tumors displays tumor-specific restriction fragment polymorphisms of the Ki-ras DNA sequences; 3) Expression of the Ki-ras gene product is increased in lung tumor cells compared to normal lung cells. Evidence suggests that these changes are more extensive than the single-base substitutions which have been observed in chemically induced or spontaneous tumors in other species.

16236 **Dose-rate evidence for two kinds of radiation damage in stationary-phase mammalian cells.** Metting, N.F.; Braby, L.A.; Roesch, W.C.; Nelson, J.M. (Pacific Northwest Lab., Richland, WA 99352). pp 118 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—). Contract AC06-76RL01830.

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Survival based on colony formation was measured for starved plateau-phase Chinese hamster ovary (CHO) cells exposed to 250 kVP x-rays at dose rates of 0.0031, 0.025, 0.18, 0.31, and 1.00 Gy/minute. A large dose-rate effect is demonstrated. Delayed plating experiments and dose response experiments following a conditioning dose, both using a dose rate of 1.00 Gy/minute and plating delays of up to 48 hours were also used to investigate the alternative repair hypotheses. There is clearly more repair in dose-rate experiments that can be accounted for by the mechanisms investigated in the other experiments. Thus the authors believe that at least two types of damage with distinct repair pathways are being manifested. They applied the Damage Accumulation Model to separate the two types of damage and estimate the repair rate for that type of damage which becomes lethal through interaction with additional damage. The mean time for repair of this sublethal damage is estimated to be 70 minutes for their CHO cells.

16237 **(DOE-tr—7014926) Repair systems and their relationship to mutagenesis in autotrophic and eukaryotic microorganisms.** Vlckova, V.; Vlcek, D. Translated from *Biologicke Listy ;* **49**: No. 4, 241-256(1984). 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014926/JAW.

The repair systems and their relationship to mutagenesis in yeasts and algae are discussed. In the yeast Saccharomyces cerevisiae there exist three light-independent types of repair, in addition to photo-repair. The systems involved are excision (error-free), mutagenic (error-prone) and minor (recombinant). Only the mutagenic repair system plays a role in the expression of induced and spontaneous mutations. In contrast with bacteria, mutagenic repair in yeasts exhibits locus specificity and dependence on mutation type. There is evidence for a significant role of repair systems in the generation of mutations after treatment with chemical mutagens. Similarly, algae contain light-independent repair systems in addition to photo-repair. An excision type of repair has been demonstrated and the recombinant and mutagenic types are assumed to exist. Like with yeasts, algae exhibit a close relation between the activity of the repair systems and mutagenesis. It follows from the existing data that repair of DNA damage in yeasts and algae is a complex process in which several genes take part. However, the role the repair processes is not merely in mutagenesis but also in other essential cell processes, such as replication, recombination, meiosis, sporulation, and others. 110 refs., 1 fig.

5602 Thermal Effects

REFER ALSO TO CITATION(S) 16241

16238 (CONF-8703206—, pp 216-233) **Current aspects in assessing the effect of air impurities on the environment.** Prinz, B. (Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen, Germany, F.R.). 1987. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751688/JAW.

From 30. anniversary of the VDI Commission on air pollution prevention; Duesseldorf, F.R. Germany (17 Mar 1987).

Schriftenreihe der VDI-Kommission Reinhaltung der Luft.; v. 6.

After a survey of historical aspects of immission protection, this lecture gives the present appearance of damage to plants and the current explanations of its causes. For coniferous trees, the loss of chlorophyll is clearly correlated to a lack of nutriment in the soil. The cause is regarded to be damage by ozone and leaching by acid deposition.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 14726, 15981, 15986, 16016, 16020, 16071, 16182, 16202, 16236, 16238

16239 (CONF-880110—13) Immunofluorescence detection for fiberoptics chemical and biological sensors. Vo-Dinh, T.; Tromberg, B.J.; Sepaniak, M.J.; Griffin, G.D.; Ambrose, K.R.; Santella, R.M. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Chemistry; Columbia Univ., New York (USA). School of Public Health). 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005054/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

This paper presents the development and application of immunofluorescence spectroscopy for fiberoptics-based chemical and biological sensors. The focus is on a fluoroimmuno-sensor SMI that combines the excellent specificity of antigen-antibody reaction, the high sensitivity of laser excitation, and the versatility of fiberoptics technology. The FIS can detect 40 attomoles (10^{-18} mole) of benzo(a)pyrene tetrol, a DNA-adduct product of the carcinogen benzo(a)pyrene. 5 refs., 6 figs.

16240 (CONF-8710226—1) Risk assessment techniques. Travis, C.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002673/JAW.

From 2. US/Japan workshop on risk assessment/risk management; Osaka, Japan (26 Oct 1987).

This report describes the risk assessment process, a portion of risk analysis. The author reviews the basic components of risk assessment in great detail, then applies these components to specific examples. He considers the problems of extrapolation of animal data to man and stresses the importance of mathematical models. In conclusion, the author suggests that the next few years will bring significant changes in the way that risk assessment is calculated. 6 figs. (TEM)

16241 (DOE/ER—0317) Physiological responses of marine organisms to environmental stresses. Dorigan, J.V.; Harrison, F.L. (eds.). (USDOE Office of Energy Research, Washington, DC. Ecological Research Div.). Apr 1987. 502p. NTIS, PC E08/MF A01; 1; GPO Dep. Order Number DE88000815/JAW.

This document contains a synthesis of research carried out over the last five years under the auspices of the Marine Physiological Ecology Program (MPEP). It covers contributions of MPEP to basic scientific knowledge, to predictive capabilities for potential environmental problems and their impact, and to economically and environmentally sound solutions to environmental problems. A general overview of major findings is presented in Part I. The overview is followed by the project summaries and representative reprints submitted by the individual investigators. This document is intended for both general educational reading and for reference use by the scientist. Individual papers are processed separately for the data base.

16242 (DOE/ER/60066—T2) A review of the 1982 Department of Energy Health and Environmental Effects Assessments on coal liquefaction and oil shale technologies. (National Research Council, Washington, DC (USA). Committee on Health and Ecological Effects of Synfuels Industries). 1983. Contract AC01-82ER60066. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004256/JAW.

The National Academy of Sciences conducted a comprehensive, critical review of the 1982 DOE Health and Environmental Effects Documents (HEEDs) on coal liquefaction and oil shale technologies. HEEDs are composed by contractors for DOE to describe potential health and environmental risks associated with emerging energy technologies. These assessments also are designed to support the formulation and management of the DOE's Health and Environmental Research Program and focus on uncertainties to aid the identification and management of research to reduce the uncertainty. The Committee evaluated the extent to which the two documents accurately used all currently available and relevant scientific and technical information and the extent to which appropriate methods were used to identify and describe uncertainty associated with risks of the technology under study.

16243 (DOE/ER/60588—11) The impact of energy-related pollutants on chromosome structure: Progress report, May 1, 1987-April 30, 1988. Rill, R.L. (Florida State Univ., Tallahassee (USA). Inst. of Molecular Biophysics). 1988. Contract FG05-87ER60588. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004921/JAW.

We have examined at the DNA sequence level the sequence specificity of binding of bis-(1,10)-phenanthroline Cu(I) complex [$(Phen)_2Cu^+$], benzo(a)pyrene-7,8-diol-9,10-epoxide, acetylacetoxy-aminofluorene, the monoazide derivative of ethidium bromide, and the monoazide derivative of actinomycin D. The techniques utilized are analogous to those of DNA sequencing. Binding sites were mapped in sea urchin and mouse histone genes cloned into pUC plasmids. The sequence specificity of $(Phen)_2Cu^+$ induced DNA cleavage was determined by mapping of cleavage sites on >2000 base pairs. We have found that $(Phen)_2Cu^+$ has a predominant preference for TAT triplets, and a moderate preference for TGT triplets; and TAAT, TAGPy, and CAGT quartets. Oligopurine and oligopyrimidine tracts are poorly reactive. We have also shown that $(Phen)_2Cu^+$ binds in the minor groove at preferred sequences. These reaction specificities are unusual for a DNA ligand and can be explained mainly in terms of a requirement for binding at the minor groove side of a pyrimidine-3', 5'-purine step and the stereoelectronic effects of 2-amino groups of guanine, which inhibit minor groove binding. Studies with synthetic minihelices have confirmed that only the local sequence is required for specificity, and that the 2-amino group of guanine does inhibit binding (for these experients inosine was substituted or guanine). We have examined, at sequence resolution, the formation of alkali-labile sites by each of the other reagents on 500 bp or more of cloned histone genes. Moderate to high specificity was observed in all cases but actinomycin D monoazide. 10 refs., 6 figs.

16244 (DOE/OR/00033—T362) Evaluation and application of an in vivo mouse assay for chemically induced sister chromatid exchanges and chromosome aberrations: Semiannual progress report, September 30, 1986-March 31, 1987. McFee, A.F. (Oak Ridge Associated Universities, Inc., TN (USA)). 20 Apr 1987. Contract AC05-76OR00033. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002402/JAW.

Our efforts involved testing chemicals submitted by the Project Officer. Ten new test compounds were received and determination of the suitable solvent for administration to mice was made for 12 chemicals. An average of 21 animals were treated with each of 10 compounds for the determination of toxicity; based on lethality and cell cycle determinations in these animals, the maximum tolerated dose was determined for each chemical. This level was then utilized as our upper dose limit for testing for cytogenetic effects. 3 refs., 1 tab.

16245 (INIS-BR—910, pp 102) Na-23 NMR spin-lattice relaxation times of livers of normal and CCl/sub 4/ treated rats. Banni, S.; Corongiu, F.P.; Dessi, M.A.; Casu, M.; Lai, A.; Vannini, V. (Cagliari Univ., Italy. Dipt. di Chimica; Cagliari Univ., Italy. Ist. di Patologia; Modena Univ., Italy. Inst. di Patologia Generale). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16246 (INIS-BR—910, pp 103) Changes in NMR relaxation times of iron-overloaded rat liver tissue. Baffa, O.; Tannus, A.; Panepucci, H.C.; Zago, M.A.; Figueiredo, M.S. (Sao Paulo Univ., Sao Carlos, SP, Brazil. Inst. de Fisica e Quimica; Sao Paulo Univ., Ribeirao Preto, Brazil. Escola de Medicina). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16247 (INIS-BR—910, pp 103) **Formation of a novel free radical metabolite from CCl/sub 4/ in the perfused rat liver and in vivo.** Connor, H.D.; Thurman, R.G.; Galizi, M.D.; Mason, R.P. (National Inst. of Environmental Health Sciences, Research Triangle Park, NC, USA; North Carolina Univ., Chapel Hill, USA. Dept. of Pharmacology). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16248 (INIS-BR—910, pp 106) **Formation of carbon centered radicals in the oxidative metabolism of hydrazine derivatives and their interaction with DNA.** Leite, L.C.C.; Nobrega, F.G.; Augusto, O. (Sao Paulo Univ., Brazil. Inst. de Quimica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16249 (LA-UR—87-3736) **Comments on the EPA/NIOSH guide to respiratory protection in the asbestos abatement industry.** Hack, A.L. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 11p. (CONF-8710223—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003173/JAW.

From ISRP conference; Toronto, Canada (22 Oct 1987).

The respirators recommended by EPA and NIOSH for asbestos are not only extreme and impractical, but more important, unlikely to provide the highest protection possible. Because of the ease of wearing, powered air purifying respirators may provide as good protection as air line devices with fewer interruptions. Placing carcinogens in the category of compounds that are considered immediately dangerous to life and health (IDLH) is a mistake and leads to error in the selection of respiratory protection.

16250 (NP—8751665) **Forestry report of the Government of the Land of Schleswig-Holstein 1985.** (Landesregierung Schleswig-Holstein, Kiel (Germany, F.R.)). 1985. 76p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751665/JAW.

The situation of forests in Schleswig-Holstein is reviewed under ecological and economic aspects. The organisation and tasks of the forest administration are presented as well as a status report on forest decline.

16251 (ORNL—6304) **Water quality criteria for 2,4,6-trinitrotoluene (TNT): Final report.** Ryon, M.G. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 140p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88002474/JAW.

Studies of the acute toxicity of TNT to aquatic organisms indicate that LC_{50} values range from 5.2 to 27.0 mg/L for invertebrates in 48-hr static tests, and from 2.0 to 3.7 mg/L for fish in 96-hr flow-through tests. TNT is absorbed by both humans and test animals through the skin, by ingestion, and by inhalation. Following oral absorption, ^{14}C-TNT is found at highest levels in the GI tract, liver, kidneys, and blood. The liver is the site for metabolic and detoxification activity. The primary effects of occupational exposure to TNT are jaundice with toxic hepatic and/or aplastic anemia that can be fetal. Significant effects on the hematological system occurred at mean exposure levels of 0.2 to 7.5 mg/m^3. Evaluations of oral TNT toxicity were reported for 90-day exposures of dogs, mice, and rats. The effects for all three species were similar and included depressed weight gain, mild to moderate anemia, enlarged livers and spleens, some testicular atrophy, and hemosiderosis of the spleen. Carcinogenicity data were limited to a 2-yr study of rats which indicated hyperplasia and carcinoma of the urinary bladder in females at the highest dose (50 mg/kg/day). Standards for TNT occupational exposures have been recommended by OSHA (TLV of 1.5 mg/m^3), US Army (0.5 mg/m^3), and ACGIH (TLV of 0.5 mg/m^3 and STEL of 0.3 mg/m^3). Drinking water limits of 0.03 to 0.05 mg/L were recommended by the US Army and Navy. Available data for calculating water quality criteria were insufficient to meet all the USEPA guideline requirements. However, a reasonable estimate of the criterion maximum concentration is 557 μg/L. 54 refs., 3 figs., 31 tabs.

16252 (PB—88-120746/XAB) **Effects of ozone on the pulmonary function of children.** Bock, N.; Lippmann, M.; Lioy, P.; Munoz, A.; Speizer, F.E. (New York Univ., NY (USA). Inst. of Environmental Medicine). 1985. 16p. NTIS, PC A03/MF A01.

Healthy active children, 7 to 13 years old, in a summer recreational camp were chosen as subjects to investigate the acute effects of exposure to ambient-air pollution. Pulmonary-function tests were administered at the camp on 16 days during a five week period in 1982. Ambient-air-pollution data were collected approximately 6 km from the camp. For each of the 39 children tested on six or more days, a linear regression was calculated between the peak one-hour ozone concentration for a given day and each of three functional parameters determined for the same day from the spirograms: forced vital capacity (FVC), Forced expiratory volume in 1 second (PEV1), and peak expiratory flow rate (PEFR). All mean slopes were negative, except for FVC in boys, indicating a general tendency for decreased function with increasing ozone concentration; however only PEFR mean slopes for girls and for all subjects were statistically significantly different from zero. For each of 49 children seen on four or more days, a summary weighted correlation coefficient between peak ozone level and each of the three pulmonary function parameters was calculated. As in the regression analysis, decrements in PEFR were significantly correlated with the ozone exposure. Overall, the decrements were small, approximately a 10% decrease in PEFR with an ozone exposure level of 120 ppb.

16253 (PB—88-123997/XAB) **Risk assessment guidelines of 1986.** (Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment). Aug 1987. 83p. (EPA—600/8-87/045). NTIS, PC A05/MF A01.

On September 24, 1986, the U.S. Environmental Protection Agency issued risk-assessment guidelines relating to five areas: carcinogenicity, mutagenicity, chemical mixtures, suspect development toxicants, and estimating exposures (51 FR 33992-34054). The guidelines were developed to promote high technical quality and Agencywide consistency in the risk-assessment process. The document presents the five guidelines as they originally appeared in the Federal Register but in a format that is easier to read.

16254 (PB—88-125422/XAB) **Experimental measurements of the uptake of ozone in rats and human subjects.** Gerrity, T.R.; Wiester, M.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Oct 1987. 16p. (EPA—600/D-87/319). NTIS, PC A03/MF A01.

Experimental determination of ozone (O_3) uptake in the conducting airways and lungs is a fundamental starting point for interspecies comparisons of delivered dose. Fractional O_3 uptake was measured in the respiratory tract of awake Fischer 344 rats and in the lungs and nasopharynx of young healthy male humans. Awake animals were individually evaluated during nose only exposures to 0.3 ppm O_3 for O_3 removal, O_2 consumption, CO_2 production and tidal breathing while inside a body plethysmograph. Utilizing these values of O_3 uptake and measures of ventilation, the mass dose rate of O_3 per unit respiratory tract surface area was computed and found to be similar between rats and humans for the same ambient O_3 concentration.

16255 (PB—88-125455/XAB) **Evaluation of the genetic activity profiles of 65 pesticides.** Garrett, N.E.; Stack, H.F.; Waters, M.D. (Environmental Health Research and Testing, Inc., Research Triangle Park, NC (USA)). 1986. 27p. NTIS, PC A03/MF A01.

Pub. in Mutation Research, Vol. 168, 301-325(1986).

This report focuses on the quantitative profiles of genetic activity produced by 65 pesticides and efforts to classify them according to their genotoxic effects and chemical structures. Three main

categories may be distinguished based on the qualitative results: Category 1 pesticides were active in most of the in vitro and in vivo assays employed. These nine compounds include the structurally similar organophosphate insecticides, acephate, demeton, monocrotophos, and trichlorfon; the phthalimid fungicide analogues, captan and folpet; and the thiocarbamate herbicide analogues, dialiate, sulfallate and triallate. The 26 Category 2 compounds demonstrated fewer positive results and may be subdivided into two parts, one of which contains 12 halogenated aromatic or heterocyclic ring compounds, including the phenoxy herbicides, 2,4-D, 2,4-DB, and 2,4,5-T. The remaining part of Category 2 (14 compounds) consists of structurally similar organophosphate insecticides, azinphosmethyl, crotoxyphos, disulfoton, methyl parathion; three similar ethylenebisdithiocarbamate fungicides, maneb, mancozeb, and zineb; three similar pyrethroid insecticides, allethrin, chrysanthemic acid, and ethy chrysanthemate; and four structurally diverse compounds, cacodylic acid, dinoseb, sec-butylamine and benomyl. The third category of 30 pesticides gave negative results in all tests and represents structurally diverse compounds. Using the computerized profile matching methodology, from 2080 possible pairwise chemical combinations of the 65 pesticides, 20 statistically significant pairs were selected.

16256 (PB—88-854849/XAB) Water-pollution effects of metals on fresh-water fish. January 1970-December 1987 (citations from the NTIS data base). Report for January 1970-December 1987. (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 116p. NTIS PC N01/MF N01.

Supersedes PB—86-876307.

This bibliography contains citations concerning laboratory and field studies regarding effects of metals on fresh water fish. Topics include toxicity studies to specific species, bioaccumulation, and the distribution and fate of metals in fresh water bodies. Copper, chromium, cadmium, mercury, and zinc are among the metals considered. (This updated bibliography contains 222 citations, 11 of which are new entries to the previous edition.)

16257 (RISO-M—2647) Physical and chemical processes of air pollutants intercepted by leaves. Larsen, B.R. (Risoe National Lab., Roskilde (Denmark)). May 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751144/JAW.

Surface-physical and -chemical processes control the actual exposure to vegetation in a given pollution climate. Accumulated dry-deposition and intercepted wet-deposition interactions mediate the pollution doses to canopies. The integrated eventual effects of air pollution are determined by leaf specific factors such as morphology, surface tension, chemical reactivity, and cuticular permeability. Following drying, significant evaporative concentration of leaf surface water occurs which may lead to tissue damage. The above mentioned processes are reviewed in this paper. 49 refs.

16258 (UCRL—97786) Mutagenic aromatic amines formed from cooking meat, metabolism and their possible significance to human health. Turteltaub, K.W.; Felton, J.S. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 10p. (CONF-8711120—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003958/JAW.

From 3. conference on current concerns in toxicity; Millbrae, CA, USA (16 Nov 1987).

Aminoimidozaarene (AIA) compounds are thought to be present in cooked meat, but as yet, have not been identified due to low mutagenic potency and mass amounts. Work is currently underway in our laboratory to identify mutagenic members of this class of compounds utilizing different methodology. We have recently developed six monoclonal antibodies named IQ-1, IQ-2, AIA-1, AIA-2, AIA-4, and AIA-7 which have shown promise in immunoassays specific for cooked food mutagens. Each of the antibodies has it's own selectivity profile for the mutagens resulting in some antibodies which are compound specific and some which are specific for the entire AIA class. We demonstrated the utility of these antibodies by showing that a high-mutagen extract of cooked meat had much more immunologically cross-reactive components than a low-mutagen extract. These antibodies also cross-react with mouse microsomal metabolites of 4,8-DiMeIQx. We hope to use these antibodies to help isolate previously unidentified members of the AIA class and to screen food items for specific mutagenic components. 27 refs.

16259 In vitro interactions between pulmonary macrophages and respirable particles. Finch, G.L.; McNeill, K.L.; Hayes, T.L.; Fisher, G.L. (Lawrence Berkeley Lab., CA). *Environmental Research;* **44**: No. 2, 241-253(Dec 1987). Contract AC03-76SF00098.

Pulmonary alveolar macrophage cells (PAM) are an important component of the pulmonary response to particle deposited in the deep lung. To more fully characterize the interactions between macrophages and particulate materials, a correlative light and electron microscopic technique was developed that allowed light microscopic identification of individual cell viability after in vitro particle exposure, followed by scanning and transmission electron microscopic analyses of specific PAM, including surface morphology, x-ray microanalytic evaluation of particle content, and internal cellular structure. Individual cell viability, particle content, and morphologic alterations were evaluated for three particle types: Ni_3S_2, TiO_2, and glass beads. Cell death and stages of cell disruption including bleb cluster formation, loes of surface features, formation of membrane tears and holes, and cell degranulation correlated with Ni_3S_2 and TiO_2 content. Glass beads were not associated with cell disruption or viability reduction. Correlative microscopic techniques were essential in describing particle-dependent effects on an individual cell basis.

16260 (EPA—560/5-87-004-Vol.5-Pt.1) National body-burden database: Chemicals identified in animals, 1985-1986: Volume 5, Part 1. Cone, M.V.; Wilson, M.; Powers, C.D.; Roesel, M.E.; Hammons, A.S. (Science Applications International Corp., Oak Ridge, TN (USA). Technical Information Analysis Div.). Dec 1987. Contract AC05-86OR21644. 362p. NTIS, PC A16; 3; GPO Dep. Order Number DE88000823/JAW.

The database provides a central source of systematically collected and organized body-burden data that facilitates the early identification of actual or potential human exposures to environmental contaminants and the assessment of the significance of such exposure. Data are obtained primarily through routine, manual searches of selected, scientific journals. Information on chemical nomenclature and properties is from online sources and standard handbooks. This publication contains introductory materials, chemical and journal lists, indices and, in tabular form, the records added to the database since the 1984 publication.

16261 (EPA—560/5-87-004-Vol.5-Pt.2) National body-burden database: Chemicals identified in animals, 1985-1986: Volume 5, Part 2. Cone, M.V.; Wilson, M.; Powers, C.D.; Roesel, M.E.; Hammons, A.S. (Science Applications International Corp., Oak Ridge, TN (USA). Technical Information Analysis Div.). Dec 1987. Contract AC05-86OR21644. 734p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88000824/JAW.

The database provides a central source of systematically collected and organized body-burden data that facilitates the early identification of actual or potential human exposures to environmental contaminants and the assessment of the significance of such exposure. Data are obtained primarily through routine, manual searches of selected, scientific journals. Information on chemical nomenclature and properties is from online sources and standard handbooks. This publication contains records added to the database since the 1984 publication.

16262 (EPA—560/5-87-003-Vol.8) National body-burden database: Chemicals identified in humans, 1985-1986: Volume 8. Cone, M.V.; Wilson, M.; Powers, C.D.; Roesel, M.E.; Hammons, A.S. (Science Applications International Corp., Oak Ridge, TN (USA). Technical Information Analysis Div.). Dec 1987. Contract AC05-86OR21644. 663p. NTIS, PC A99; 3; GPO Dep. Order Number DE88000827/JAW.

The database provides a central source of systematically collected and organized body-burden data that facilitates the early identification of actual or potential human exposures to environ-

mental contaminants and the assessment of the significance of such exposure. Data are obtained primarily through routine, manual searches of selected, scientific journals. Information on chemical nomenclature and properties is from online sources and standard handbooks. This publication contains introductory materials, chemical and journal lists, indices and, in tabular form, the records added to the database since the 1984 publication.

16283 (EPA—560/5-87-004-Vol.5-Pt.4) National body-burden database: Chemicals identified in animals, 1985-1986: Volume 5, Part 4. Cone, M.V.; Wilson, M.; Powers, C.D.; Roesel, M.E.; Hammons, A.S. (Science Applications International Corp., Oak Ridge, TN (USA). Technical Information Analysis Div.). Dec 1987. Contract AC05-86OR21644. 778p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88000826/JAW.

The database provides a central source of systematically collected and organized body-burden data that facilitates the early identification of actual or potential human exposures to environmental contaminants and the assessment of the significance of such exposure. Data are obtained primarily through routine, manual searches of selected, scientific journals. Information on chemical nomenclature and properties is from online sources and standard handbooks. This publication contains records added to the database since the 1984 publication.

16284 (EPA—560/5-87-004-Vol.5-Pt.3) National body-burden database: Chemicals identified in animals, 1985-1986: Volume 5, Part 3. Cone, M.V.; Wilson, M.; Powers, C.D.; Roesel, M.E.; Hammons, A.S. (Science Applications International Corp., Oak Ridge, TN (USA). Technical Information Analysis Div.). Dec 1987. Contract AC05-86OR21644. 736p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88000825/JAW.

The database provides a central source of systematically collected and organized body-burden data that facilitates the early identification of actual or potential human exposures to environmental contaminants and the assessment of the significance of such exposure. Data are obtained primarily through routine, manual searches of selected, scientific journals. Information on chemical nomenclature and properties is from online sources and standard handbooks. The publication contains records added to the database since the 1984 publication.

16285 Effect of temperature on the occurrence of O_2 and CO_2 insensitive photosynthesis in field grown plants. Sage, R.F.; Sharkey, T.D. (Desert Research Institute, Reno, NV). *Plant Physiology, Supplement;* **83**: No. 4, 68(Apr 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

The sensitivity of photosynthesis to O_2 and CO_2 was measured in field grown plants of six species (Phaseolus vulgaris, Capsicum annum, Lycopersicon esculentum, Scrophularia desertorum, Cardaria draba and Populus Fremontii) from 5°C to 35°C. Photosynthesis was insensitive to O_2 in normal air below a species dependent temperature. CO_2 insensitivity occurred under the same conditions that resulted in O_2 insensitivity. A complete loss of O_2 sensitivity was observed up to 22°C (in Lycopersicon) but only up to 6°C (in Scrophularia). In Lycopersicon and Populus, O_2 and CO_2 insensitivity occurred under conditions regularly encountered during the cooler portions of the day. The authors believe that O_2 insensitivity is an indicator of feedback limited photosynthesis, and that these results indicate that feedback limitations can play a role in determining plant carbon gain in the field. At higher partial pressures of CO_2 the temperature at which O_2 insensitivity occurred was higher, indicating that feedback limitations in the field will become more important as the CO_2 concentration in the atmosphere increases.

16286 Seasonal and diurnal water use patterns of Pinus ponderosa seedlings exposed for two years with elevated carbon dioxide. Houpis, J.L.J.; Surano, K.A.; Shinn, J. (Univ. of California, Livermore). *Plant Physiology, Supplement;* **83**: No. 4, 45(Apr 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

Pinus ponderosa seedlings were placed in standard open-top field chambers and were exposed to one of four levels of carbon dioxide (CO_2). The levels of CO_2 were ambient ($350\mu LL^{-1}$) ambient $+75\mu LL^{-1}$, ambient $+150\mu LL^{-1}$, and ambient $+300\mu LL^{-1}$. During the second year of treatment, the authors collected stomatal conductance measurements every other week. Both pre-dawn and mid-day relative water content (RWC) and water potential measurements were made four times over the growing season. Elevated CO_2 caused a reduction in stomatal conductance. However, RWC and water potential were significantly lower in the $+150\mu LL^{-1}$ and $+300\mu LL^{-1}$ treatments. Plants in these high CO_2 treatments had a greater canopy surface area, and thus possibly a greater canopy transpiration rate. This may explain the apparent drought conditions at the higher CO_2 levels.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 14889

16287 (AD-A—185776/2/XAB) Effects of simultaneous radiofrequency radiation and chemical exposure of mammalian cells. Volume 1. Annual report, 2 January-31 December 1984. Meltz, M.L. (Texas Univ., San Antonio (USA). Health Science Center). Aug 1987. 55p. NTIS, PC A04/MF A01.

The major objective of this project was to determine whether radiofrequency radiation (RFR), at power densities and specific absorption rate (SAR) values which can result in temperature increases in the exposure medium, can affect the extent of chemically induced toxicity, mutagenicity, sister chromatid exchange, or chromosome aberrations in mammalian cells. The in-vitro system used for toxicity and mutagenicity studies is the mouse leukemic L5178Y cell thymidine kinase locus mutation assay.

16288 Interaction of extremely low frequency electric and magnetic fields with humans. Tenforde, T.S.; Kaune, W.T. (Lawrence Berkeley Lab., Berkeley). *Health Physics;* **53**: No. 6, 585-606(Dec 1987).

The dosimetry and physical interaction mechanisms of electromagnetic fields with frequencies in the extremely low frequency (ELF) range (below 300 Hz) are described. The mechanisms through which ELF electric and magnetic fields induce electric currents in living organisms are summarized, with particular emphasis on humans. Topics that are discussed include: (1) sources and measurements of ELF electric and magnetic fields; (2) direct and indirect coupling of these fields to humans; (3) transient discharges and contact currents, and the thresholds for human response to these phenomena; (4) protective measures for the mitigation of potential ELF field effects on humans; and (5) mechanisms of interaction of ELF fields with cellular and tissue systems, with emphasis on field transduction mechanisms involving the cell membrane.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 16006, 16253

16289 (VTT-TIED—682) Research field of fire technology in Finland. Loikkanen, P.; Holm, C. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Feb 1987. 68p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751094/JAW.

The importance of systematic research to maintain and develop the fire safety of society is increasing. The goal of the study has been to give an overview of the whole diversified research field of fire technology and its problems. For this reason the research subjects have been grouped so that the responsibilities of different authorities, the legislation and specifications, various fields of technology, areas of industry, and groups of products could all be found as clearly as possible. The field has been divided into nine sub-areas. They are: general grounds, fire physics and chemistry, structural fire prevention, textiles and furnishings, devices for heating and other use, detection, fire fighting and rescue, quality control, and special problems. The sub-areas have been divided into 34

main subjects and these, excluding those of special problems, further into as many as 117 subject groups. Characteristics and problems of the sub-areas and the main subjects have been described. The subject groups have been characterized by key words and concepts which outline the projects. No concrete research projects and programs have, however, been directly suggested because their extent and contents depend essentially on financing and other available resources.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 14257

16270 **(GSF—41/86-Pt.1&2) Glacial hydrology.** Moser, H.; Escher-Vetter, H.; Oerter, H.; Reinwarth, O.; Zunke, D. (eds.). (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Radiohydrometrie; Bayerische Akademie der Wissenschaften, Muenchen (Germany, F.R.). Kommission fuer Glaziologie). 1986. 569p. (In German). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88751493/JAW.

Glacial hydrology studies in the Hintereisferner and Kesselwandferner glaciers (Rosenache, Oetztal Alps, Austria) are reported. This comprises intraglacial drainage rates and paths and times of residue of the molten water inside and near the glacier as determined by tracer studies (T, D, 0-18, fluorescence tracers). With 1 separate map.

16271 (INIS-BR—910, pp 55) **ESR dating of Brazilian fish fossil.** Matsuoka, M.; Takatohi, U.; Tatumi, S.H.; Watanabe, S. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16272 **(ORNL/Sub—86-78911/3) Evaluation of sinkhole occurrence in the Valley and Ridge Province, East Tennessee: Phase 3.** Newton, J.G.; Tanner, J.M. (LaMoreaux (P.E.) and Associates, Inc., Tuscaloosa, AL (USA)). Nov 1987. Contract AC05-84OR21400. 115p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004907/JAW.

Data from a reconnaissance-type inventory of sinkhole occurrence and from more detailed inventories in selected areas were used to determine regional density and frequency of sinkhole occurrence in the Valley and Ridge Province, Tennessee. The overall database consisted of 333 sinkholes of which 211, or 63 percent of the total, were classified as induced. Almost all induced sinkholes resulted from construction activities, such as grading, ditching, and impoundment of water. Extrapolation of data to provide estimates of regional sinkhole density necessitated adjustment of the reconnaissance inventory. Adjustment factors were calculated by comparing reconnaissance inventories from selected areas with those obtained from detailed inventories in the same areas. The number of sinkholes in the detailed inventories was 5 and 8.5 times greater than the number in the reconnaissance inventories.

16273 **(USGS—474-320) Review of lithologic logs of selected exploratory and emplacement drill holes completed between November 1975 and November 1983 in Area 7, Nevada Test Site, Nye County, Nevada.** Sharps, J.A. (Geological Survey, Denver, CO (USA)). Oct 1987. Contract AI08-76DP00474. 142p. (NTS—266). NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88005080/JAW.

This report is an additional compilation of selected lithologic logs of exploratory and emplacement drill holes in Area 7, Nevada Test Site, Nye County, Nevada. It supplements two earlier publications, USGS-474-152 and USGS-474-211. Included are logs of 39 drill holes in which descriptions of the Quaternary and Tertiary alluvium and Tertiary volcanic units are emphasized.

16274 **Trace-element anomalies at the Mississippian/Pennsylvanian boundary in Oklahoma and Texas.** Orth, C.J.; Quintana, L.R.; Gilmore, J.S.; Grayson, R.C. Jr.; Westergaard, E.H. (Los Alamos National Lab., NM). *Geology;* 14: No. 12, 986-990(Dec 1986).

Trace-element abundance anomalies have been found at the Mississippian/Pennsylvanian boundary at sites in Oklahoma and Texas where the boundary has been precisely located on the basis of an abrupt change in conodont diversity and species composition. Enriched elements include osmium, iridium, platinum, chromium, most chalcophiles, rare earths, and uranium. The anomalies are more intense (e.g., Os = 4 ppb, Ir = 0.38 ppb, Pt = 6 ppb, Cr = 12,000 ppm, U = 380 ppm) and persist through a thicker interval at the south-central Texas locality than in Oklahoma, and in both locations the anomalies are associated with an increase in phosphate content of the rocks. There is no tangible evidence of an asteroid or comet impact source for the excess Pt-group elements and faunal crisis. The cause of the elemental enrichments and the biological disturbance may possibly be related to a change in the ocean chemistry of the Paleozoic seaway, such as increased upwelling, stagnation, or nearby submarine volcanism.

16275 **Stratigraphic occurrences of iridium anomalies at four Cretaceous/Tertiary boundary sites in New Zealand.** Brooks, R.R.; Strong, C.P.; Lee, J.; Orth, C.J.; Gilmore, J.S.; Ryan, D.E.; Holzbecher, J. (Massey Univ., Palmerston North, New Zealand). *Geology;* 14: No. 9, 727-729(Sep 1986).

Three new iridium anomaly sites have been discovered in Cretaceous/Tertiary boundary sequences in New Zealand. These are at Needles Point, Chancet Rocks, and Waipara, where integrated iridium deposition values were 165, 211, and 7 ng/cm^2, respectively. In contrast to the previously reported Woodside Creek stratigraphic sequence that had an iridium anomaly of 187 ng/cm^2, a ferruginous boundary clay is absent in the three new sites, though the base of the Tertiary is marked by limonite staining. The relatively weak anomaly at the Waipara section is probably due to extensive bioturbation coupled with a high sedimentation rate at the time of deposition. The discovery of these additional boundary rock sequences in New Zealand negates suggestions that the Woodside Creek iridium.

16276 **Late Devonian Kellwasser Event mass-extinction horizon in Germany: no geochemical evidence for a large-body impact.** McGhee, G.R. Jr.; Orth, C.J.; Quintana, L.R.; Gilmore, J.S.; Olsen, E.J. (Rutgers, The State Univ. of New Jersey, New Brunswick). *Geology;* 14: No. 9, 776-779(Sep 1986).

The hypothesis that the Late Devonian (Frasnian-Famennian) mass extinction was triggered by an asteroidal impact has received renewed attention with the discovery of a Late Devonian Ir anomaly in Australia. In Europe, the mass-extinction event corresponds stratigraphically to the geographically widespread Kellwasser black-shale and bituminous limestone units, and the biological crisis itself has been alternatively designated the Kellwasser Event. The authors report here the results of an extensive geochemical analysis of the Kellwasser stratigraphic interval in a section with exceptional conodont zonal control in the Federal Republic of Germany. No Ir anomaly was found, neither at the biological crisis horizon recognized in Europe nor at the conodont horizon that corresponds to the Ir anomaly zone reported in Australia. No shock-metamorphosed quartz, sanidine spherules, or siderophile-rich magnetic spherules were found, which might have been indicative of a cometary impact. Oxygen-isotope ratios show little variation across the mass-extinction horizon, though carbon-isotope data suggest a sudden increase in phytoplankton activity. They further note that the Australian Ir anomaly (1) is most likely not associated with a large-body impact because no equivalent Ir signature occurs in Europe and (2) is stratigraphically above the European biological crisis horizon, thus postdating the Kellwasser mass-extinction event.

5802 Geophysics

REFER ALSO TO CITATION(S) 14040, 14473, 16289, 16290

16277 (UCID—21281) Numerical simulation of solute transport in randomly heterogeneous porous media: Motivation, model development, and application. Tompson, A.F.B.; Vomvoris, E.G.; Gelhar, L.W. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004909/JAW.

A particle tracking, or "crandom walk" solute transport model is developed to study detailed contaminant movements through large, synthetic heterogeneous flow systems in porous media. Such simulations can be used to examine the large time and spatial effects of the variable flow field on the expanding solute plumes. More specifically, the large scale experimental dispersive behavior can be compared with theoretical prediction based upon stochastic analyses. The particle tracking model is developed from first principles and is shown to be the most computationally efficient model for this type of application. Computational issues regarding the model's implementation are discussed, including the choice of time steps, boundary and initial conditions, and conversion of solutions to concentration fields. The model is applied to some simple test problems and then to two large, three-dimensional, heterogeneous, saturated flow systems. The results of these preliminary investigations are analyzed and compared with results of stochastic theories. They are also used to plan more comprehensive simulations to be carried out in the future. 67 refs., 19 figs., 7 tabs.

16278 Mapping of serpentinites in the Eastern Desert of Egypt by using Landsat thematic mapper data. Sultan, M.; Arvidson, R.E.; Sturchio, N.C. (Washington Univ., St. Louis, MO). *Geology;* **14**: No. 12, 995-999(Dec 1986).

Serpentinites in the Eastern Desert of Egypt were mapped from Landsat thematic mapper (TM) data by using procedures that take advantage of the distinctive spectral reflectance of these rocks caused by the abundance of antigorite, lizardite, clinochrysotile, and magnetite. The method employs a threshold classifier based on three reflectance ratios: (1) band 5/7 for estimating the abundance of hydroxyl-bearing phases, (2) band 5/1 for magnetite content, and (3) the calculated value of reflectance for band 4, based on a linear interpolation between bands 3 and 5, divided by the observed band-4 reflectance. The third ratio was used to identify rocks in iron-bearing aluminosilicates and thereby to distinguish mafic rocks containing substantial amounts of magnetite and hydroxyl-bearing phases from serpentinites. The method was first successfully tested over the Meatiq dome and Wadi Ghadir areas, where serpentinites and ophiolitic melanges dominated by serpentinites have been mapped during the course of field work. A TM-based map was then generated; the map covered about 60,000 km^2 in the Eastern Desert. Results demonstrate that TM data can be used with reliability to distinguish serpentinites from surrounding rocks in arid regions and to generate detailed maps over wide regions by using quantitative, reproducible mapping criteria. Possibilities for locating suture zones over the less well known parts of arid continents are clear.

16279 14 August 1983 Cimarron, Colorado earthquake and the Cimarron fault. Wong, I.G.; Humphrey, J.R. (Woodward-Clyde Consultants, San Francisco, CA). *Mountain Geologist;* **23**: No. 1, 14-18(Jan 1986).

On 14 August 1983, a small earthquake of Richter magnitude 3.4 occurred near the town of Cimarron in southwestern Colorado. The analysis of data collected from seismographic stations located within the intermountain US suggests the earthquake occurred on the Cimarron fault, a major west-northwest trending Precambrian fault which has experienced displacement possibly since Oligocene time. A fault plane solution determined for the earthquake exhibits normal faulting on a moderately dipping, west-northwest- or east-west-trending fault plane in good agreement with the geologic observations of the Cimarron fault. The fault plane solution also displays a north-northeast trending minimum compressive stress suggesting that this earthquake occurred in response to a reactivation of the Cimarron fault in an extensional tectonic stress field similar to that observed in the Rio Grande rift to the southeast or the Southern Great Plains to the east. The location and the faulting characteristics of the Cimarron earthquake represent the best evidence to date that associates an earthquake with a known major fault in Colorado.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 14213, 14730, 14731

16280 (UCRL—96313) Relationship between large-hole drilling rates and compressive strength of NTS [Nevada Test Site] rock types. Anderson, G.D.; Rambo, J.T.; Kusubov, A.S.; Dockery, H.A.; McKinnis, W.B. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 11p. (CONF-870961—7). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005219/JAW.

From 4. symposium on containment of underground nuclear explosions; Colorado Springs, CO, USA (21 Sep 1987).

Calculations to simulate and evaluate nuclear test containment require data on the strength of the geologic media at the work point and in the surrounding region. Studies cited in the literature reveal correlations between mechanical properties of rocks and various drilling parameters of large horizontal boring machines that share similarities with drilling assemblies used at the Nevada Test Site (NTS). An extensive selection of downhole core samples spanning the strength range of NTS rocks has been collected, stratigraphically and petrologically identified, and tested for strength as a function of confining pressure. Detailed data on the drilling rates are available for similar geologic units identified in the compilation and also for the specific rocks from these vertical holes that were tested. These data are used to discuss a preliminary empirical correlation between reported laboratory-measured compressive strength and drilling rates for various NTS rock types.

16281 (UCRL—96317) Measurement of in-situ strength using projectile penetration: Tests of a new launching system. Hearst, J.R.; Newmark, R.L.; Charest, J.A.; Lynch, C.S. (Lawrence Livermore National Lab., CA (USA); Dynasen, Inc., Goleta, CA (USA)). Oct 1987. Contract W-7405-ENG-48. 40p. (CONF-8710196—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001882/JAW.

From Minerals and Geotechnical Logging Society symposium; Golden, CO, USA (6 Oct 1987).

The Lawrence Livermore National Laboratory has a continuing need to measure rock strength in situ, both for simple prediction of cavity size, and as input to computational models. In a previous report we compared two methods for measuring formation strength in situ: projectile penetration and a cone penetrometer. We determined that the projectile method was more promising for application to our large-diameter (2-4-m) hole environment. A major practical problem has been the development of a launcher and an apparatus for measuring depth of penetration that would be suitable for use in large-diameter holes. We are developing a gas-gun launcher system that will be capable of measuring both depth of penetration and deceleration of a reusable projectile. The current version of the launcher is trailer-mounted for testing at our Nevada Test Site (NTS) in tunnels and outcrops, but its design is such that it can be readily adapted for emplacement hole use. We test the current launcher on 60-cm cubes of gypsum cement, mixed to provie a range of densities (1.64 to 2.0 g/cc) and strengths (3 to 17 MPa). We compared depth of penetration of a 84-g projectile from a "Betsy" seismic gun - traveling on the order of 500 m/s - with the depth of penetration of a 13-kg projectile from the gas gun - traveling on the order of 30 m/s. For projectiles with the same nose size and shape, impacting targets of approximately constant strength, penetration depth was proportional to projectile kinetic energy. The ratio of kinetic energy to penetration depth was approximately proportional to target strength. Tests in tuffs with a wide range of strengths at NTS gave a similar linear relationship between the ratio of kinetic energy to penetration and target strength, and also a linear relationship between deceleration and strength. It appears that penetration can indeed be used as a semi-quantitative measure of strength.

16282 Note on the description of surface roughness using fractal dimension. Brown, S.R. (Geomechanics Division, Sandia National Laboratories). *Geophysical Research Letters;* **14**: No. 11, 1095-1098(Nov 1987).

Self-affine fractals are useful models of the surfaces of rock fractures. The scaling properties of these surfaces are described by two parameters, the fractal dimension and the crossover length. Two methods for estimating the fractal dimension of a profile of a rough surface are compared, the divider method and the spectral method. It is shown that the two methods yield the same results, if the horizontal resolution at which the profile is measured is smaller than the crossover length. However, for resolutions greater than the crossover length, the divider method always gives a fractal dimension close to 1. To guide future work, the crossover length is estimated for typical joint surfaces and for the San Andreas fault. Additionally, a simple method is proposed to obtain the correct fractal dimension without prior knowledge of the crossover length. copyright American Geophysical Union 1987

16283 Elastic interface waves along a fracture. Pyrak-Nolte, L.J.; Cook, N.G.W. (Department of Material Science & Mineral Engineering, University of California, Berkeley and Earth Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California). *Geophysical Research Letters;* **14**: No. 11, 1107-1110(Nov 1987).

Non-welded interfaces can be treated as a displacement discontinuity characterized by elastic stiffnesses. Applying this boundary condition to a generalized Rayleigh wave, it is shown that a fast and a slow dispersive wave can propagate along the fracture, even when the seismic properties of the rock on each side are identical.

16284 Thermal diffusivity of igneous rocks at elevated pressure and temperature. Durham, W.B.; Mirkovich, V.V.; Heard, H.C. (University of California, Lawrence Livermore National Laboratory, Livermore, California). *Journal of Geophysical Research;* **92**: No. B11, 11615-11634(10 Oct 1987).

Thermal diffusivity measurements of seven igneous rocks were made to temperatures of 400 °C and pressures of 200 MPa. The measuring method was based on the concept of cylindrical symmetry and periodic heat pulses. The seven rocks measured were Westerly (Rhode Island) granite, Climax Stock (Nevada) quartz monzonite, Pomona (Washington) basalt, Atikokan (Ontario, Canada) granite, Creighton (Ontario, Canada) gabbro, East Bull Lake (Ontario, Canada) gabbro, and Stripa (Sweden) granite. The diffusivity of all the rocks showed a positive linear dependence on inverse temperature and, excluding the East Bull Lake gabbro, showed a linear dependence on quartz content. (Quartz content varied from 0 to 31% by volume.) Diffusivity in all cases rose or remained steady with increasing confining pressure. The pressure effect was strongest at lowest pressures and vanished by levels between 10 and 100 MPa, depending on rock type. The pressure effect (measured as a percentage change in diffusivity) is stronger in the four rocks of granite composition than in the three of basaltic composition. Our results agree well with existing thermal diffusivity measurements at atmospheric pressure.

5804 Geochemistry

REFER ALSO TO CITATION(S) 14305, 14326, 16274, 16275, 16276

16285 (LA—10965-MS) Geochemical Atlas of the San Jose and Golfito quadrangles, Costa Rica. (Los Alamos National Lab., NM (USA); Ministerio de Industria, Energia y Minas, San Jose (Costa Rica); Escuela Centroamericana de Geologia, San Jose (Costa Rica)). Jul 1987. Contract W-7405-ENG-36. 448p. (In English and Spanish). NTIS, PC A19. Order Number DE88005127/JAW.

The Geochemical Atlas of the San Jose and Golfito 1:200,000-scale quadrangles, Costa Rica, was produced to help stimulate the growth of the Costa Rican mining industry and, thus, to benefit the economy of the country. As a result of the geochemical data presented in the Atlas, future exploration for metallic minerals in Costa Rica can be focused on specific areas that have the highest potential for mineralization. Stream-sediment samples were collected from drainage basins within the two quadrangles. These samples were analyzed for 50 elements and the results were displayed as computer-generated color maps. Each map shows the variation in abundance of a single element within the quadrangle. Basic statistics, geological and cultural data are included as insets in each map to assist in interpretation. In the Golfito quadrangle, the geochemical data do not clearly indicate undiscovered gold mineralization. The areas known to contain placer (alluvial) gold are heavily affected by mining activity. Statistical treatment of the geochemical data is necessary before it will be possible to determine the gold potential of this quadrangle. In San Jose quadrangle, gold and the pathfinder elements, arsenic and antimony, are indicators of the gold mineralization characteristic of the Costa Rican gold district located in the Tilaran-Montes del Aguacate Range. This work shows that high concentrations of these elements occur in samples collected downstream from active gold mines. More importantly, the high concentrations of gold, arsenic, and antimony in sediment samples from an area southeast of the known gold district suggest a previously unknown extension of the district. This postulated extension underlain by Tertiary volcanic rocks which host the gold deposits within the gold district. The geochemical data, displayed herein, also indicate that drainage basins north of Ciudad Quesada on the flanks of Volcan Platanar have high gold potential.

5805 Oceanography

REFER ALSO TO CITATION(S) 14094, 15357

16286 (DOE/ER/60351—T3) Nearshore transport processes affecting the dilution and fate of energy-related contaminants: Three-year progress report, January 1985-December 1987. Blanton, J.O. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 1 Dec 1987. Contract FG09-85ER60351. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003199/JAW.

This report summarizes progress over a 3-year period. This contract is one of several components in the DOE regional program of Coastal Oceanography in the southeastern US, hereafter called the South Atlantic Bight (SAB). Three major field experiments have been completed. The first was conducted in support of the DOE Spring Runoff Experiment (SPREX). We also conducted a pilot field experiment in autumn of 1986 as a precurser to the major autumn effort called FLEX (FaLl EXperiment). The field plans of both of the autumn experiments are described together with a summary of findings for the autumn 1986 work. Research has encompassed a combination of theoretical and experimental work in order to understand the role of coastal fronts and associated circulation processes in transporting material on the continental shelf of the SAB. A major effort is underway to study the formation and dissipation of fronts such as midshelf fronts found in the winter in the SAB and the coastal front formed by estuarine inputs off South Carolina and Georgia. We have also described the frictional response of currents on the continental shelf and the response of shelf currents on the "remote" disturbances of storms of the Gulf Stream. 5 refs., 7 figs.

16287 (DOE/ER/60354—T3) Biological processes in the water column of the South Atlantic Bight: Zooplankton responses: [Technical] progress report, June 1987 to July 1988. Paffenhoefer, G.A. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 16 Dec 1987. Contract FG09-85ER60354. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003941/JAW.

We report interdisciplinary efforts to understand interactions of physical, chemical, and biological processes on the southeastern continental shelf of the USA. One effort will determine the physical forces responsible for upwelling on the northeastern Florida and Georgia shelf during summer, trajectories and fate of those upwellings, and major chemical and biological processes therein. Additional experiments will determine the extent of removal of nearshore water towards offshore, and the fate of plankton between Savannah and Cape Fear. We suspect that strong north- to eastward wind stress could displace large volumes of low-salinity nearshore water rapidly across the shelf to the Gulf Stream. A third study

quantified the cycling of nitrogen in the estuary and nearshore zone. Our contribution was to determine consumption, excretion and excrementation of nitrogen by abundant metazooplankton during winter and summer. In a fourth study strong southward wind stress during fall maintains low salinity water close to the coast and displaces it southward. We suspect that this nearshore water was transported offshore near Cape Canaveral, or further north across the north Florida shelf when winds would change to northward. 5 refs., 2 figs.

16288 **(DOE/ER/60555—T1) Transport and transfer rates in the waters of the Continental Shelf and slope: SEEP: Annual report, 1 May 1987-30 April 1988.** Biscaye, P.E.; Anderson, R.F.; Houghton, R.W. (Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory). Dec 1987. Contract FG02-87ER60555. 12p. (COC—60555-1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004189/JAW.

This has been a year of transition from SEEP-I to SEEP-II with some introductory attention given to SEEP-III and other post-SEEP-II possibilities. This report reflects this transition in its organization. The papers are still in preparation and analytical work on SEEP-I data and samples is still in progress. Activities included sediment trap development and the testing and the analysis of samples obtained in those tests. Specific planning for the scientific and logistical details of SEEP-II continues. 1 tab.

16289 **Uniformity and diversity in the composition of mineralizing fluids from hydrothermal vents on the southern Juan de Fuca Ridge.** Philpotts, J.A.; Aruscavage, P.J.; Von Damm, K.L. (U.S. Geological Survey, Reston, Virginia). *Journal of Geophysical Research;* 92: No. B11, 11327-11333(10 Oct 1987).

Abundances of Li, Ni, K, Rb, Ca, Sr, Ba, Mn, Fe, Zn, and Si have been determined in fluid samples from seven vents located in three areas on the southern Juan de Fuca Ridge. The hydrothermal component estimated from the Mg contents of the samples ranges from 7% to 76%. Concentrations of Fe and Si, among the other elements, in acid-stabilized solutions appear to be generally representative of the parental hydrothermal fluids, but some Zn determinations and most Ba values appear to be too low. Thermodynamic calculations indicate that the acidified samples remain supersaturated with respect to silica, barite, and pyrite; unacidified samples are supersaturated, in addition with respect to ZnS, FeS, and many silicate phases. Within the constraints of limited sampling there appear to be differences in fluid compositions both within and between the three vent areas. Some uniform differences in the elemental abundances predicted for hydrothermal end-member fluids might be due to inmixing of fresh seawater at depth in the hydrothermal system. The Juan de Fuca hydrothermal fluids contain more Fe but otherwise have relative elemental abundances fairly similar to those in 13 °N (East Pacific Rise) fluids, albeit at higher levels. In contrast, fluids from 21 °N (East Pacific Rise) and Galapagos have lower K/Rb and much lower Sr and Na abundances; these compositional features probably result from interaction of these fluids with a different mineral assemblage, possibly more mature greenstone. copyright American Geophysical Union 1987

16290 **Chemistry of hydrothermal solutions from the southern Juan de Fuca Ridge.** Von Damm, K.L.; Bischoff, J.L. (Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee). *Journal of Geophysical Research;* 92: No. B11, 11334-11346(10 Oct 1987).

Fluids from three vent fields on the southern Juan de Fuca Ridge were sampled in September 1984 using the DSRV Alvin. The fluids are uniquely high in both chloride, which ranges up to twice the seawater value, and in metal content. Simple vapor-liquid phase separation could not have produced both the high chlorinity and gas concentrations observed in these fluids. The cause of the elevated chlorinity can not be uniquely identified but may be the result of either or a combination of two processes: (1) subsurface formation of a degassed brine and subsequent mixing of a small amount of this brine with a hydrothermal seawater which has not undergone a phase separation and (2) dissolution of a chloride-rich phase combined with a possible small loss of gas during sampling procedures. Although measured temperatures were all less than 300 °C, quartz geothermometry suggests that the fluids have equilibrated at greater than 340 °C. Quartz geobarometry is also in agreement with geophysical estimates of depth to the local magma chamber. copyright American Geophysical Union 1987

64 PHYSICS I

REFER ALSO TO CITATION(S) 16761, 16762

16291 **(INIS-SU—427) JINR rapid communications. Collection.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1986. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780043/JAW.

Individual papers have been indexed separately. (WRF)

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 15406, 15892, 15893, 15894, 15895, 15896, 16600, 16691, 16889, 17105, 17106, 17369, 17369

16292 **(BNL—40413) Supernova mechanisms: Before and after SN1987a.** Kahana, S.H. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 10p. (CONF-8709186—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003489/JAW.

From IAU colloquium No. 108 - atmospheric diagnostics of stellar evolution: chemical peculiarity, mass loss, and explosion; Tokyo, Japan (1 Sep 1987).

The impact of SN1987a on theoretical studies of the specific mechanism generating Type II supernovae is examined. The explosion energy extracted from analysis of the light curve for SN 1987a is on the edge of distinguishing between a prompt explosion from a hydrodynamic shock and a delayed, neutrino-induced, explosion. The detection of neutrinos from 1987a is also reanalyzed. 30 refs., 2 tabs.

16293 **(CBPF-NF—008/87) Notes on a class of homogeneous space-times.** Calvao, M.O.; Reboucas, M.J.; Teixeira, A.F.F.; Silva Junior, W.M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700138/JAW.

The breakdown of causality in homogeneous Goedel-type space-time manifolds is examined. An extension of Reboucas-Tiomno (RT) study is made. The existence of noncausal curves is also investigated under two different conditions on the energy-momentum tensor. An integral representation of the infinitesimal generators of isometries is obtained extending previous works on the RT geometry.

16294 **(CEA-CONF—9012) SN 1987A. Theory.** Schaeffer, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Mar 1987. 12p. (CONF-870390—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751333/JAW.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

SN 1987A was unique in many aspects. The most striking, undoubtedly, is its low luminosity, nearly two orders of magnitude below the expectations based on supernovae currently observed in external galaxies. The rise time of the optical emission, usually a few days, was for SN 1987A, of the order of a few hours. Also its surface temperature is surprisingly low, 5000K. The neutrino burst has been detected. It was observed twice, with a time difference of 5 hours, the second burst occurring within 3 hours of the onset of the optical signal. In this talk, I will discuss how these strange events fit with the theoretical models of supernova explosions, how they differ in some cases, and try to evaluate the degree of certainty -or uncertainty- of our present knowledge on how these extremely powerful star explosions occur.

16295 (CEA-CONF—9159, pp 34-37) **Propagation of cosmic rays with continuous acceleration.** Ferrando, P.; Soutoul, A. (CEA CEN Saclay, 91 - Gif-sur-Yvette, France. IRF, Service d'Astrophysique). Aug 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW. (CONF-870855—).

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

Secondary/primary abundance ratios and primary spectra are calculated in a leaky box model with continuous reacceleration. The escape lengths values around 1 GeV and their energy dependence are found significantly smaller than in a pure leaky box calculation, even with small amounts of reacceleration.

16296 (CEA-CONF—9159, pp 38-41) **MSW regeneration of solar and supernova V in the earth.** Cribier, M.; Lagage, P.O.; Rich, J.; Spiro, M.; Vignaud, D.; Hampel, W. (CEA CEN Saclay, 91 - Gif-sur-Yvette, France. IRF, Service d'Astrophysique; Max Planck Institut fuer Kernphysik, Heidelberg, Germany, F.R.). Aug 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW. (CONF-870855—).

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

We discuss the MSW (Mikheyev-Smirnov-Wolfenstein) effect for different radiochemical and real-time neutrino experiments taking into account the effects of the passage through the earth for solar and supernova neutrinos. We emphasize that V/sub e/ regeneration in the earth can lead to measurable increases in counting rates and to a time dependent V/sub e/ energy spectrum. Such observations would verify the presence of the MSW effect and lead to a restriction on the allowed values of neutrino mass differences and mixing angles.

16297 (CEA-CONF—9159, pp 42-45) **Low energy cosmic-ray antineutrinos.** Lagage, P.O. (CEA CEN Saclay, 91 - Gif-sur-Yvette, France. IRF, Service d'Astrophysique). Aug 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW. (CONF-870855—).

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

The production of cosmic-ray electron antineutrinos (CRantiν/sub e/) from the decay of secondary neutrons (n) is considered. In general, this way of antiν production accounts for ~80% of the total CR antiν/sub e/ production; but as the n-decay antiν have an energy ~ 4 10/sup 3/ times lower than that of their progenitors, it is only at energies below 10 MeV that these antiν can compete with the antiν/sub e/ produced via the pion-decay channel. The low energy antiν/sub e/ fluxes expected from CR interactions in various environments (earth atmosphere, interstellar medium, CR sources, galactic center) are calculated and compared with low energy antiν fluxes from other sources, either astrophysical or terrestrial.

16298 (CEA-CONF—9159, pp 46-47) **Reappraisal of the standard solar model.** Cahen, S.; Casse, M.; Doom, C. (CEA CEN Saclay, 91 - Gif-sur-Yvette, France. IRF, Service d'Astrophysique; Vrije Universiteit Brussel, Belgium). Aug 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW. (CONF-870855—).

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

16299 (CEA-CONF—9159, pp 48-49) **Weakly interacting massive particles and solar neutrinos.** Bouquet, A.; Salati, P.; Casse, M.; Prantzos, N. (Paris-7 Univ., 75, France; Grenoble Univ., 74 - Annecy, France. Laboratoire de Physique des Particules; CEA CEN Saclay, 91 - Gif-sur-Yvette, France. IRF, Service d'Astrophysique; Institut d'Astrophysique, 75 - Paris, France). Aug 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW. (CONF-870855—).

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

WIMP's have been introduced in astrophysics for cosmological reasons but have also been appealed to solve the solar neutrino puzzle. In this short note we draw attention on numerical difficulties encountered in solar models including these hypothetical particles and present preliminary results.

16300 (CEA-CONF—9159, pp 50-52) **Effect of a convective core on the solar neutrino emission.** Cahen, S.; Casse, M.; Doom, C. (CEA CEN Saclay, 91 - Gif-sur-Yvette, France. IRF, Service d'Astrophysique; Vrije Universiteit Brussel, Belgium). Aug 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW. (CONF-870855—).

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

16301 (CEA-CONF—9159) **Service d'astrophysique. Contributions to the 20th international cosmic ray conference.** (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Aug 1987. 54p. (In French). (CONF-870855—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW.

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

The thirteen communications included in this conference are separately analysed and indexed. Some are presented in abstracted form.

16302 (CEA-CONF—9159, pp 6-9) **Gamma-ray/gas correlations over the whole galaxy.** Strong, A.W.; Bloemen, J.B.G.M.; Dame, T.M.; Nyman, L.A.; Thaddeus, P.; Grenier, I.A.; Lebrun, F.; Hermsen, W.; Pollock, A.M.T. (Max-Planck-Institut fuer physik und Astrophysik, Garching, Germany, F.R.; California Univ., Berkeley, USA; Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA; CEA CEN Saclay, 91, Gif-sur-Yvette, France. IRF, service d'Astrophysique; Laboratory for Space Research, Leiden, Netherlands). Aug 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW. (CONF-870855—).

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

A new compilation of CO and HI surveys covering the entire Galactic plane has been used together with the final COS-B data to study the distribution of γ-ray emissivity and the gas content of the Galaxy. The agreement between the model and the observations is excellent. A summaryy of the results for γ-ray energies>150MeV is given.

16303 (CEA-CONF—9159, pp 14-17) **Sigma space telescope for low-energy gamma-ray astronomy.** Paul, J.; Lebrun, F.; Mandrou, P.; Roques, J.P. (CEA CEN Saclay, 91, Gif-sur-Yvette, France. IRF service d'Astrophysique; Centre d'Etude Spatiale des Rayonnements, 31 - Toulouse, France). Aug 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW. (CONF-870855—).

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

The Soviet spacecraft GRANAT, to be launched in the near future, will carry the French telescope SIGMA, designed to obtain high-sensitivity images of the sky in the 30-2000 keV energy range, with an unprecedented angular accuracy. The principal objective of the experiment will be to locate and study galactic and extragalactic celestial bodies where high-energy phenomena take place. The telescope features a coded mask 2.5m away from a position-sensitive detector, surrounded by a thick anticoincidence shield. An operational life time in excess of 18 months is foreseen, so that hundreds of targets can each be observed. In this paper, we describe the key figures and the anticipated performances of the instrument in the light of the principal scientific objectives of the mission.

16304 (CEA-CONF—9159, pp 18-21) **Simulated high resolution observation by the sigma telescope of the low energy gamma-ray emission from the galactic center region based on recent observational results.** Laudet, P.; Roques, J.P.; Guerry, A.; Mandrou, P.; Paul, J.; Lebrun, F. (Centre d'Etude Spatiale des Rayonnements, 31 - Toulouse, France; CEA CEN Saclay, 91- Gif-sur-Yvette, France. IRF, Service d'Astrophysique). Aug 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW. (CONF-870855—).

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

Simulated high resolution images of the galactic center region have been obtained for the SIGMA telescope, using recent observational data. It is shown, using various computing methods, that the next generation of gamma-ray imaging telescopes will be able to resolve this complex region of the sky.

16305 (CEA-CONF—9159, pp 22-25) **Assessment of GRASP as a prospective ESA gamma ray astronomy mission.** Bignami, G.; Villa, G.; Dean, A.J. (IFCTR-CNR, Milan, Italy; Southampton Univ., UK). Aug 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW. (CONF-870855—).

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

The GRASP mission - Gamma-Ray Astronomy with Spectroscopy and Positioning was originally proposed as a prospective European astronomy mission by the representatives of a wide European community. The project was selected by ESA for a detailed assessment study which was duly completed in December 1986. The telescope has been designed as a high quality spectral imager ($E/\Delta E \sim 1000$, $\Delta\theta \sim 6'$) which operates over a wide spectral range (15 keV to $> \sim 100$ MeV) with a (3σ) sensitivity of typically 10 m Crab or better over the entire operational range within an observation period of 10/sup 5/s. Two principal mission scenarios were considered.

16306 (CEA-CONF—9159, pp 26-29) **Models of cosmic ray sources: the possible role of the ionization cross section.** Arnaud, M.; Rothenflug, R.; Casse, M. (CEA CEN Saclay, 91 - Gif-sur-Yvette, France. IRF, Service d'Astrophysique). Aug 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW. (CONF-870855—).

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

We confirm that a clear correlation exists between the Cosmic Ray Source/Local Galactic abundance ratio and the ionization cross section of the corresponding neutral elements, as pointed out originally by Krisstianson in 1971. However we are not able to propose a firm explanation to this empirical fact.

16307 (CEA-CONF—9159, pp 30-33) **Cosmic ray acceleration by large scale galactic shocks.** Cesarsky, C.J.; Lagage, P.O. (CEA CEN Saclay, 91 - Gif-sur-Yvette, France. IRF, Service d'Astrophysique). Aug 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW. (CONF-870855—).

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

The mechanism of diffusive shock acceleration may account for the existence of galactic cosmic rays detailed application to stellar wind shocks and especially to supernova shocks have been developed. Existing models can usually deal with the energetics or the spectral slope, but the observed energy range of cosmic rays is not explained. Therefore it seems worthwhile to examine the effect that large scale, long-lived galactic shocks may have on galactic cosmic rays, in the frame of the diffusive shock acceleration mechanism. Large scale fast shocks can only be expected to exist in the galactic halo. We consider three situations where they may arise: expansion of a supernova shock in the halo, galactic wind, galactic infall; and discuss the possible existence of these shocks and their role in accelerating cosmic rays.

16308 (CEA-CONF—9159, pp 2-5) **Contribution of Wolf-Rayet stars to the /sup 26/Al content and γ-ray line luminosity of the galaxy revisited.** Prantzos, N.; Casse, M.; Arnould, M. (Institut d'astrophysique, 75 - Paris, France; CEA CEN Saclay, 91 - Gif-sur-Yvette; France; Universite Libre de Brussels, Belgium; IRF, Service d'Astrophysique). Aug 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751721/JAW. (CONF-870855—).

From 20. international cosmic ray conference; Moscow, USSR (2 Aug 1987).

On the basis of recent data, we evaluate the contribution of the winds of massive stars to the /sup 26/Al content and the γ-ray line luminosity of the Galaxy at 1.8 MeV. We find that they can account for a substantial part (but not all) of the amount of /sup 26/Al inferred from the observations.

16309 (CEA-CONF—9162) **Quasi-static evolution of a two-dimensional force-free field. Application to theories of flares and corona heating.** Aly, J.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Mar 1987. 3p. (In French). (CONF-8703235—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751843/JAW.

From Workshop on Soho Themis; Paris, France (5 Mar 1987).

16310 (CEA-CONF—9163) **Prominances in equilibrium in a force-free field.** Amari, T.; Aly, J.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Mar 1987. 4p. (In French). (CONF-8703235—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751844/JAW.

From Workshop on Soho Themis; Paris, France (5 Mar 1987).

16311 (CNES-RA—1986) **[French research and development in space technology and basic sciences]. Progress report 1986.** (Centre National d'Etudes Spatiales, 31 - Toulouse (France)). 1987. 72p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751849/JAW.

In this report are included the general presentation of the French space program, and other themes like the fundamental research and space, the basic technical studies, the application programs, the operation activities, the international relations, the industrial and commercial business, the quality politics, and the operation of the center.

16312 (EFI—871(22)-86) **Relative chaos in stellar systems.** Gurzadyan, V.G.; Kocharyan, A.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700148/JAW.

Statistical properties of many-dimensional dynamical system -stellar systems of different types, are investigated by means of estimation of Ricci curvature in the direction of the velocity of geodesics. Numerical experiment is performed to calculate the Ricci and scalar curvatures for systems with equal total energy. The results of calculations enable one to obtain schematic classification of stellar systems by increasing degree of chaos. 19 refs.

16313 (FNAL/C—87/161-A) **A look at Supernova 1987A.** Schramm, D.N. (Fermi National Accelerator Lab., Batavia, IL (USA); Chicago Univ., IL (USA)). Oct 1987. Contract AC02-76CH03000. 30p. (CONF-870797—12). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003411/JAW.

From International symposium on lepton and photon interactions at high energies; Hamburg, F.R. Germany (27 Jul 1987).

Supernova 1987A is reviewed with emphasis on the neutrino observations. It is shown that the results fit well with the expectations for neutrino temperatures ($T \sim 4_{\epsilon_0}4.5$ MeV) and total energy emitted ($2_{\epsilon_0}4 \times 10^{53}$ ergs). It is argued that the detection tends to favor collapse models that yield emission for 10 second timescales with a $1_{\epsilon_0}2$ second early accretion phase followed by Kelvin-Helmholtz cooling as opposed to prompt shocks with the immediate onset of cooling. It is also argued that the probable detection of one

or more electron scattering event favors a superthermal tail at high energies. Neutrino mass limits and flavor limits are comparable to laboratory experiments. An estimate for future collapse rates in our galaxy of 1/7 year is made based on nucleosynthesis yields. The supernova also has eliminated many axion and majoron models. 69 refs., 3 figs., 27 tabs.

16314 **(FNAL/C—87/163-A) Hadron-quark phase transition in dense stars.** Grassi, F. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1987. Contract AC02-76CH03000. 30p. (CONF-8708202—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003412/JAW.

From Quark matter '87: 6th international conference on ultra-relativistic nucleus-nucleus collisions; Schloss Nordkirchen, F.R. Germany (1 Aug 1987).

An equation of state is computed for a plasma of one flavor quarks interacting through some phenomenological potential, at zero temperature. Assuming that the confining potential is scalar and color-independent, it is shown that the quarks undergo a first-order mass phase transition. In addition, due to the way screening is introduced, all the thermodynamic quantities computed are independent of the actual shape of the interquark potential. This equation of state is then generalized to a several quark flavor plasma and applied to the study of the hadron-quark phase transition inside a neutron star. 45 refs., 4 figs.

16315 **(FNAL/C—87/164-A) Cosmic strings: A problem or a solution?.** Bennett, D.P.; Bouchet, F.R. (Fermi National Accelerator Lab., Batavia, IL (USA); Chicago Univ., IL (USA). Astronomy and Astrophysics Center; California Univ., Berkeley (USA). Dept. of Astronomy; Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract AC02-76CH03000. 7p. (CONF-8707143—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003410/JAW.

From NATO ASI: the post-recombination universe; Cambridge, UK (27 Jul 1987).

The most fundamental issue in the theory of cosmic strings is addressed by means of Numerical Simulations: the existence of a scaling solution. The resolution of this question will determine whether cosmic strings can form the basis of an attractive theory of galaxy formation or prove to be a cosmological disaster like magnetic monopoles or domain walls. After a brief discussion of our numerical technique, results are presented which, though still preliminary, offer the best support to date of this scaling hypothesis. 6 refs., 2 figs.

16316 **(FNAL/C—87/166-A) Big Bang nucleosynthesis: Accelerator tests and can Ω/sub B/ really be large.** Schramm, D.N. (Fermi National Accelerator Lab., Batavia, IL (USA); Chicago Univ., IL (USA)). Oct 1987. Contract AC02-76CH03000. 10p. (CONF-8708165—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003405/JAW.

From Symposium on the origin and distribution of elements; New Orleans, LA, USA (31 Aug 1987).

The first collider tests of cosmological theory are now underway. The number of neutrino families in nature, N/sub nu/, plays a key role in elementary particle physics as well as in the synthesis of the light elements during the early evolution of the Universe. Standard Big Bang Nucleosynthesis argues for N/sub nu/ = 3 +- 1. Current limits on N/sub nu/ from the CERN anti pp collider and e^+e^- colliders are presented and compared to the cosmological bound. Supernova SN 1987A is also shown to give a limit on N/sub nu/ comparable to current accelerator bounds. All numbers are found to be small thus verifying the Big Bang model at an earlier epoch than is possible by traditional astronomical observations. Future measurements at SLC and LEP will further tighten this argument. Another key prediction of the standard Big Bang Nucleosynthesis is that the baryon density must be small (Ω/sub B/ ≤ 0.1). Recent attempts to try to subvert this argument using homogeneities of various types are shown to run afoul of the ^{7}Li abundance which has now become a rather firm constraint. 18 refs., 2 figs.

16317 **(FNAL/C—87/168-A) Quark matter in astrophysics and cosmology.** Olinto, A.V. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1987. Contract AC02-76CH03000. 13p. (CONF-8708202—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003406/JAW.

From Quark matter '87: 6th international conference on ultra-relativistic nucleus-nucleus collisions; Schloss Nordkirchen, F.R. Germany (1 Aug 1987).

We dicuss the role of quark matter in astrophysics and cosmology. The implications of the dynamics of the quark-hadron phase transition in the early universe for the element abundances from big bang nucleosynthesis and the composition of the dark matter in the universe are addressed. We discuss the possibility of deciding on an equation of state for high density matter by observing the cooling of a neutron star remnant of SN1987A. Quark matter models for the Centauros events, Cygnus X-3 cosmic ray events, high energy gamma-ray bursts and the solar neutrino problem are described. 25 refs., 3 figs.

16318 **(IFUSP-P—605) Can the causal pathologies of Goedel-type universes be avoided in higher-derivative gravity.** Accioly, A.J.; Goncalves, A.T. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Oct 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700185/JAW.

A completely causal rotating Goedel-type universe is obtained in the context of higher-derivative gravity. The solution is such that it has no similar in the framework of standard general relativity. The aforementioned solution presents the interesting feature of relating the mass of the nontachyonic spin-O particle, concerning the linearized higher-derivative theory, with the velocity of rigid rotation of matter.

16319 **(IN2P3—86-03) Cosmology and elementary particles. Heavy ion collisions.** Billoire, A.; Blanchard, A.; Kounnas, C.; London, G.; Salati, P.; Schaeffer, P.; Schneider, J.; Soyeur, M. (eds.). (Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France)). 1986. 327p. (In French and English). (CONF-8409260—). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751392/JAW.

From CERN accelerator school; Gif-sur-Yvette, France (3 Sep 1984).

These school lectures were centered around two principal subjects: first tried to show how cosmology and particle physics are deeply related more and more nowadays. Second one was around heavy ion collisions and their relations with quark matter.

16320 (IN2P3—86-03, pp 177-232) **Classical relativistic cosmology reviews.** Schneider, J. (Paris-7 Univ., 75, France; Observatoire de Paris-Meudon, 92 - Meudon, France). 1986. (In French). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751392/JAW. (CONF-8409260—).

From CERN accelerator school; Gif-sur-Yvette, France (3 Sep 1984).

Astronomical observations show a certain number of facts: matter is uniformly spread about Universe. Universe is expanding. When one adds the hypothesis that universe dynamics is governed by Einstein's equations and that its contents is mainly a particle gas at temperature T, there results a thermal history of Universe that follows an inescapable course. All these predictions are compatible with observations. This classical model meets two difficulties, however: the problem of horizon. The problem of the arbitrary excess percentage of matter over antimatter. These difficulties are solved by the new hypothetical cosmology deduced from Grand Unification Theories.

16321 (IN2P3—86-03, pp 149-176) **Maximally symmetric supergravity inflationary universe.** Kounnas, C. (Ecole Normale Superieure, 75 - Paris, France. Lab. de Physique Theorique). 1986. NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751392/JAW. (CONF-8409260—).

From CERN accelerator school; Gif-sur-Yvette, France (3 Sep 1984).

We present an inflationary model which is based on a maximally symmetric N=1 supergravity (M.S. SUGRA). We show that

within this model, the standard cosmological and scale stability problems, which are associated with the grand unification and "big-bang" cosmology, are naturally solved. The gravitino mass is heavy m/sub 3/2/ ≃ 10/sup 12/ GeV, thus avoiding the light gravitino problem which was a common fact in all previous SUGRA models. The SU(5) phase transition to the SU(3)XSU(2)XU(1) phase, is induced by the inflation and the magnetic monopoles are diluted during the inflationary epoch. The baryon-antibaryon cosmological asymmetry is created during the reheating epoch after the inflation.

16322 (IN2P3—86-03, pp 101-147) **Classical model face to face with the observations.** Blanchard, A. (Paris-7 Univ., 75, France; Observatoire de Paris-Meudon, 92 - Meudon, France). 1986. (In French). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751392/JAW. (CONF-8409260—).

From CERN accelerator school; Gif-sur-Yvette, France (3 Sep 1984).

I review several observations which prove very important for cosmology. The check of basic hypotheses (homogeneity and isotropy) by object (e.g. galaxies) counting is in fact rather poor. On the other hand hypotheses may be tested much more seriously by the 3/sup 0/K radiation background, which is observed to be far extragalactic. In this context, the classical model is by far the most satisfactory. I present thus a review of the "geometrical" properties of this model, including a cosmological constant in Einstein's equations. I recall then the conclusions that may be derived from observations on the determination of Hubble's constant, of Universe's average density, and of the cosmological constant. Finally, orders of magnitude are determined for different terms capable of creating temperature fluctuations in the cosmological background. Difficulties of this model connected with galaxy formation are briefly mentioned.

16323 (IN2P3—86-03, pp 39-99) **Cosmology and particle physics.** Salati, P. (Grenoble Univ., 74 - Annecy-le-Vieux. Lab. de Physique des Particules). 1986. (In French). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751392/JAW. (CONF-8409260—).

From CERN accelerator school; Gif-sur-Yvette, France (3 Sep 1984).

If the hot Big Bang model is correct, the very early universe provides us with a good laboratory to test our ideas on particle physics. The temperature and the density at that time are so high that each known particle must exist in chemical and in thermal equilibrium with the others. When the universe cools, the particles freeze out, leaving us today with a cosmic background. Such a kind of relic is of great interest because we can probe the Big Bang Model by studying the fossilized gas of a known particle. Conversely we can use that model to derive information about a hypothetical particle. Basically the freezing of a gas occurs a temperature T/sub o/ and may be thermal or chemical. Studying the decoupling of a stable neutrino brings information on its mass: if the mass M/sub ν/ lies in the forbidden range, the neutrino has to be unstable and its lifetime is constrained by cosmology. As for the G.U.T. Monopole, cosmology tells us that its present mass density is either to big or to small (1 monopole/observable universe) owing to a predicted flux far from the Parker Limit. Finally, the super red-giant star life time constrains the axion or the Higgs to be more massive than .2 MeV.

16324 (INIS-BR—871) **Atmospheric families with SE/sub γ/ > 100 TeV detected in nuclear emulsion and lead chambers exposed at Chacaltaya Mountain.** Maldonado, R.H.C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Mar 1980. 128p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700205/JAW.

Hadronic interactions from cosmic radiation with observed energy greater than 100TeV, using a high statistics, are analyzed. Only hadronic interactions in the atmosphere are considered, using a method in which the height of the interactions is implicitly taking into account. The data belong to the Brazil-Japan Collaboration.

16325 (INIS-mf—11009) **Stellar magnetic activity. Complementing conclusions based on solar and stellar observations.** Schrijver, C.J. (Rijksuniversiteit Utrecht (Netherlands)). 22 Sep 1986. 236p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700216/JAW.

The stellar emission in the chromospheric Ca II H+K lines is compared with the coronal soft X-ray emission, measuring the effects of non-radiative heating in the outer atmosphere at temperatures differing two orders of magnitude. The comparison of stellar flux densities in Ca II H+K and X-rays is extended to fluxes from the transition-region and the high-temperature chromosphere. The stellar magnetic field is probably generated in the differentially rotating convective envelope. The relation between rotation rate and the stellar level of activity measured in chromospheric, transition-region, and coronal radiative diagnostics is discovered. X-ray observations of the binary λ Andromedae are discussed. The departure of M-type dwarfs from the main relations, and the implications for the structure of the chromospheres of these stars are discussed. Variations of the average surface flux densities of the Sun during the 11-year activity cycle agree with flux-flux relations derived for other cool stars, suggesting that the interpretation of the stellar relations may be furthered by studying the solar analogue in more detail.

16326 (INIS-mf—11010) **Homogeneous viscous universes with magnetic field.** Salvati, G.A.Q. (Amsterdam Univ. (Netherlands)). 3 Dec 1986. 184p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700217/JAW.

In this thesis homogeneous universes are studied containing a large scale magnetic field. In the evolution three different phases are distinguished: the lepton, the plasma and the matter dominated eras. During the lepton and plasma eras, which form the radiation dominated phase, the material contents of the universe are taken to consist of a viscous fluid. The transport properties taking place during this radiation dominated period are described with the help of relativistic kinetic theory, thereby taking into account the effect of the magnetic field on the shear viscosity. In the matter dominated phase the contents of the universe mainly consists of dust and, therefore, viscosity is absent during this period.

16327 (INIS-mf—11014) **Spectroscopic study of absorption and emission features of interstellar dust components.** Zwet, G.P. van der. (Rijksuniversiteit Leiden (Netherlands)). 19 Nov 1986. 169p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700221/JAW.

The spectroscopic properties of silicate interstellar dust grains are the subject of this thesis. The process of accretion and photolysis is simulated in the laboratory by condensing mixtures of gases onto a cold substrate (T — 12 K) in a vacuum chamber and photolyzing these mixtures with a vacuum ultraviolet source. Alternatively, the gas mixtures may be passed through a microwave discharge first, before deposition. The spectroscopic properties of the ices are investigated using ultraviolet, visible and infrared spectroscopy. 182 references, 56 figures, 10 tables.

16328 (INIS-mf—11020) **Thermal-nonthermal relationships in active galactic nuclei.** Waard, G.J. de. (Rijksuniversiteit Leiden (Netherlands)). 2 Dec 1986. 241p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700227/JAW.

This dissertation reports on optical and radio observations of active galactic nuclei, selected on the basis of the presence of dominant narrow (narrow line radio galaxies, Seyfert II galaxies, QSOs) and/or broad (broad line radio galaxies, Seyfert I galaxies, QSOs) optical emission lines in their spectra. Special attention is drawn to possible relationships and physical links between the two regimes responsible for the optical (thermal) and radio (non-thermal) emission. Several projects, each studying such relationships on different angular (and thus linear) scales and at different observational frequencies were conceived with a variety of detection devices. 304 references, 52 figures, 37 tables.

16329 (INIS-mf—11027) Studies of accreting and non-accreting neutron stars. Stollman, G.M. (Amsterdam Univ. (Netherlands)). 15 Apr 1987. 191p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700234/JAW.

This thesis is divided into three parts. Part A is devoted to the statistical study of radio pulsars, in which the observations of nearly all known pulsars are used to study their properties such as magnetic field strengths, rotation periods, space velocities as well as their evolution in time. Part B is devoted to the modelling and understanding of quasi-periodic oscillations (QPO) in low-mass X-ray binaries. But, this study is mainly concerned with the accretion process in these sources, and one may hope to learn more about the neutron stars in these systems when the understanding of QPO is improved. In Part C the problem of super-Eddington luminosities in X-ray burst sources is treated. The idea is that a good understanding of the burst process, which takes place directly at the surface of the neutron star, will eventually improve our understanding of the neutron stars themselves. 277 references, 42 figures.

16330 (LA-UR—87-4104) Measurements of astrophysical reaction rates for radioactive samples. Koehler, P.E.; O'Brien, H.A.; Bowman, C.D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 11p. (CONF-871245—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004309/JAW.

From Workshop on nuclear spectroscopy of astrophysical sources; Washington, DC, USA (14 Dec 1987).

Reaction rates for both big-bang and stellar nucleosynthesis can be obtained from the measurement of (n,p) and (n,γ) cross sections for radioactive nuclei. In the past, large backgrounds associated with the sample activity limited these types of measurements to radioisotopes with very long half lives. The advent of the low-energy, high-intensity neutron source at the Los Alamos Neutron Scattering CEnter (LANSCE) has greatly increased the number of nuclei which can be studied. Results of (n,p) measurements on samples with half lives as short as fifty-three days will be given. The astrophysics to be learned from these data will be discussed. Additional difficulties are encountered when making (n,γ) rather than (n,p) measurements. However, with a properly designed detector, and with the high peak neutron intensities now available, (n,γ) measurements can be made for nuclei with half lives as short as several weeks. Progress on the Los Alamos (n,γ) cross-section measurement program for radioactive samples will be discussed. 25 refs., 3 figs., 1 tab.

16331 (LA-UR—87-4159) The relation of solar wind structure to hydromagnetic discontinuities. Alexander, C.J.; Neugebauer, M.; Smith, E.J.; Bame, S.J. (California Inst. of Tech., Pasadena (USA); Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-8708141—7). NTIS, PC A02. Order Number DE88004304/JAW.

From 6. meeting of solar wind; Estes Park, CO, USA (24 Aug 1987).

High resolution ISEE-3 data have been used to examine the relative abundances of tangential (TD) vs rotational (RD) discontinuities in different types of solar wind flow. Three types of flow were examined; flow from coronal holes, sector boundary flow and transient flow. It has been found that coronal hole flow has substantially more discontinuities and a greater ratio of RD's to TD's than do the other types of flow. Discontinuities are least frequent in transient flows characterized by bidirectional streaming of electrons. This leads us to the conclusion that meaningful studies of the velocity dependence of the rates of occurrence of different types of discontinuities must take the type of flow (coronal hole versus transient) into account. 7 refs., 3 figs., 1 tab.

16332 (LAL—87-21) Search for dark matter and neutrino sources with the Frejus detector. Kuznik, B.; Arpesella, C.; Bareyre, P. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Apr 1987. 6p. (CONF-870164—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751413/JAW.

From 7. Moriond workshop: searches for new and exotic phenomena; Les Arcs, France (24 Jan 1987).

A high energy neutrino flux from the sun is expected if the sun contains significant amounts of dark matter in the form of weak interacting massive particles, which may be gravitationally bound and annihilate in the solar core. High energy gamma ray sources could be also sources for high energy neutrinos due to the production in hadronic cascades. A search has been done for high energy neutrinos coming from the sun, Cyg X3, the galactic center and different other galactic objects.

16333 (LAPP-TH—191-87) Capture and equilibrium of cosmions in stars. Bouquet, A.; Salati, P. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Jun 1987. 19p. (LPTHE—87-34). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751756/JAW.

We present capture rates and equilibrium distributions of cosmions in the sun and in main sequence stars.

16334 (PREPRINT—18) Kinematics and galactic structure. Sandage, A. (Johns Hopkins Univ., Baltimore, MD (USA)). Dec 1986. 21p. NTIS, PC A03/MF A01.

A radial velocity and photometric study of some 900 high proper motion stars in the solar neighborhood, recently completed at Mount Wilson, is combined with the earlier subdwarf literature to review the dependencies of kinematics on metallicity. The data confirm the conclusion that the oldest stars, with only a very few exceptions, are moving on highly eccentric orbits, and have higher W velocities than younger stars. The interpretation is again put forward for a collapse from a larger volume as the formation process of the Galaxy.

16335 (RAL—86-085) Flares: solar and stellar. Rutherford Appleton Laboratory workshop on astronomy and astrophysics, Abingdon, 19-21 May 1986. Gondhalekar, P.M. (ed.). (Rutherford Appleton Lab., Chilton (UK)). May 1986. 251p. (CONF-8605310—). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750881/JAW.

From Workshop on astronomy and astrophysics: flares - solar and stellar; Abingdon, UK (19 May 1986).

The paper concerns solar and stellar flare phenomena reported at the Rutherford Appleton Laboratory Workshop on Astronomy and Astrophysics, May 1986. Eleven papers were presented at the Workshop on: the solar-stellar connection, observational evidence for solar and stellar flares, and flare models; and all are indexed separately.

16336 (RAL—86-085, pp 1-41) **Solar-type phenomena in stars: an overview of the solar-stellar connection.** Pallavicini, R. (Osservatorio di Arcetri, Florence, IT). May 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750881/JAW. (CONF-8605310—).

From Workshop on astronomy and astrophysics: flares - solar and stellar; Abingdon, UK (19 May 1986).

An overview is given of the solar-stellar connection with emphasis on the following topics: (1) the relationship between convection, rotation and magnetic fields in stars possessing subphotospheric convection zones; (2) the observational evidence for the presence of solar-type phenomena in stars at various atmospheric levels; (3) the modelling of magnetically confined coronal structures during quiescent as well as flaring conditions.

16337 (RAL—86-085, pp 42-64) **Early stages of solar flares.** Simnett, G.M. (Birmingham Univ., GB. Dept. of Space Research). May 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750881/JAW. (CONF-8605310—).

From Workshop on astronomy and astrophysics: flares - solar and stellar; Abingdon, UK (19 May 1986).

Observations around the onset time of solar flares are reviewed. Particular attention is given to those processes which are important for an understanding of the energetics of a flare. The observations are put in the context of outstanding questions relevant to the development of solar flare models. Eight specific measurements are selected which the author believes are generally applicable to large flares and which provide critical constraints on the boundary conditions for models.

16338 (RAL—86-085, pp 65-80) **Observational aspects of the thermal phase of solar flares.** Phillips, K.J.H. (Rutherford Appleton Lab., Chilton, UK). May 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750881/JAW. (CONF-8605310—).

From Workshop on astronomy and astrophysics: flares - solar and stellar; Abingdon, UK (19 May 1986).

The paper reviews the observational aspects of the thermal phase of solar flares. Attention is focused on the soft x-ray plasma as the dominant part of the flare thermal phase, and the observations and the deduced physical characteristics of this hot plasma are described. Other observations of the soft x-ray flare are given including: time variations, soft x-ray oscillations, interaction of soft x-ray emission with chromosphere and abundance variations. The thermal phase in radio and extreme and near ultraviolet wavelengths is also outlined.

16339 (RAL—86-085, pp 81-104) **Solar-type activity phenomena amongst the dKe-dMe stars.** Butler, C.J. (Armagh Observatory, Northern Ireland, UK). May 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750881/JAW. (CONF-8605310—).

From Workshop on astronomy and astrophysics: flares - solar and stellar; Abingdon, UK (19 May 1986).

The paper explores whether stellar observations can give insight into solar phenomena. In particular, the evidence for solar type activity in late type dwarfs is examined, and the implications for solar studies are considered if these activity phenomena are confirmed to be present on other stars. Spots on late-type dwarfs or the BY Draconis syndrome, rotational modulation of chromospheric and coronal emission, and energetics of flares on dKe-dMe stars and its relevance to coronal heating, are all discussed.

16340 (RAL—86-085, pp 105-123) **Flares in RS CVn stars.** Catalano, S. (Catania Univ., IT. Inst. of Astronomy). May 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750881/JAW. (CONF-8605310—).

From Workshop on astronomy and astrophysics: flares - solar and stellar; Abingdon, UK (19 May 1986).

The observational aspects of the flare events in RS CVn binaries are reviewed. The main results from observations in the optical continuum, optical and UV lines, X-ray and radio wavelengths suggest that outbursts are time linked at all spectral bands. Physical parameters of flares and VLBI measurements indicate that flares take place in regions of the stellar size with typical conditions: 1) electron energy E 1-10 MeV; 2) magnetic field B 30-50 Gauss; 3) ambient thermal gas densities n approx. = 10 cm^{-3}. Occurrence of flares in Algol and UMa systems are discussed in the context of the RS CVn phenomena they present.

16341 (RAL—86-085, pp 124-139) **Flarelike variability on T Tauri stars.** Gahm, G.F. (Stockholm Observatory, Saltsjoebaden, SE). May 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750881/JAW. (CONF-8605310—).

From Workshop on astronomy and astrophysics: flares - solar and stellar; Abingdon, UK (19 May 1986).

The paper reviews the work carried out on the flarelike variability on T Tauri stars. Most of the flare event work has examined the X-ray variability, far ultraviolet variability and optical variability of the T Tauri stars, with some radio and infrared investigations. Data from these studies are discussed, together with the processes connected with the variability.

16342 (RAL—86-085, pp 140-156) **MHD of solar flares.** Priest, E.R. (Saint Andrews Univ., UK). May 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750881/JAW. (CONF-8605310—).

From Workshop on astronomy and astrophysics: flares - solar and stellar; Abingdon, UK (19 May 1986).

The paper reviews the magnetohydrodynamics of solar flares. The basic magnetic instability responsible for a flare is discussed with respect to the kink instability of a loop configuration and the eruptive instability of an arcade. Magnetic reconnection, creation of 'post'-flare loops by reconnection, and the role of the emerging flux and moving satellite spots, are all examined.

16343 (RAL—86-085, pp 157-200) **Impulsive phase of solar flares: theory.** Mackinnon, A.L. (Glasgow Univ., UK). May 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750881/JAW. (CONF-8605310—).

From Workshop on astronomy and astrophysics: flares - solar and stellar; Abingdon, UK (19 May 1986).

The paper reviews the theoretical interpretation of impulsive phase phenomena in solar flares. The impulsive phase is defined to be that period of approx. 10 - 100s duration, during which the flare radiative output undergoes its most rapid, dramatic increase and decrease. The interpretation of the various impulsive phase radiation signatures are examined, including the i) hard x-ray emission, ii) radio emission, iii) UV, Hα and white light emissions and iv) gamma-ray emission. The acceleration mechanisms are discussed with respect to candidate acceleration mechanisms, and the synthesis of the theory and observations.

16344 (RAL—86-085, pp 201-223) **Solar flares: thermal phase models.** MacNeice, P. (Rutherford Appleton Lab., Chilton, UK). May 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750881/JAW. (CONF-8605310—).

From Workshop on astronomy and astrophysics: flares - solar and stellar; Abingdon, UK (19 May 1986).

The paper reviews the work carried out on the thermal phase models of solar flares. The scope of soft x-ray flare models, development of soft x-ray loop models, numerical models, comparison of models and observations, non-maxwellian distribution functions, and optically thick power loss, are all discussed.

16345 (RAL—86-085, pp 224-231) **Flares: the solar-stellar perspective and opportunities.** Haisch, B.M. (Lockheed Palo Alto Research Labs., CA, USA). May 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750881/JAW. (CONF-8605310—).

From Workshop on astronomy and astrophysics: flares - solar and stellar; Abingdon, UK (19 May 1986).

The paper outlines eight specific areas in which the fundamental concepts of flare physics can be tested and refined via a solar-stellar approach. These areas are: electron beam versus superthermal heating of the lower flare atmosphere, the chromospheric and photospheric response, microflaring and the heating of coronae and the driving of winds, flare rates and power spectra, mass motions, elemental abundance anomalies during flares, periodicities including links to the interior structure of the sun and stars, and flaring on other dMe stars.

16346 (RAL—86-085, pp 232-240) **T Tauri stars: flare characteristics and flare models.** Giampapa, M.S. (National Solar Observatory, Tucson, AZ, USA). May 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750881/JAW. (CONF-8605310—).

From Workshop on astronomy and astrophysics: flares - solar and stellar; Abingdon, UK (19 May 1986).

The paper reviews the flare properties of T Tauri stars, and concentrates on the transient activity in the stars that is likely analogous to solar flares. Flare observations for T Tauri stars are described, including the results of x-ray and radio flare events. Work carried out on the T Tauri flare models is also discussed.

16347 (RAL—86-085, pp 241-251) **Summary and conclusions.** Oord, G.H.J. van den. (Rijksuniversiteit Utrecht, Netherlands. Sterrewacht Sonnenborgh). May 1986. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750881/JAW. (CONF-8605310—).

From Workshop on astronomy and astrophysics: flares - solar and stellar; Abingdon, UK (19 May 1986).

A concluding and summarizing article is presented for papers given at the Rutherford Appleton Laboratory Workshop on Astronomy and Astrophsics, May 1986. The workshop investigated solar and stellar flare phenomena. The conclusions include: the present understanding, new observations, possible new developments, and status of required atomic data. The topics discussed in the summary include: global analogies between solar and stellar activity, initial phase of the solar flare, gradual phase of the solar

flare, x-ray flare on HR 1099, observational status of flare star research, and T Tauri stars.

16348 **(RAL—87-068) Spectroscopic study of chemical abundances in the globular cluster Omega Centauri.** Caldwell, S.P. (Rutherford Appleton Lab., Chilton (UK)). Oct 1987. 85p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751834/JAW.

Blue spectra at a resolution of 0.5 A of red giants in the globular clusters Omega Centauri and NGCs 288, 362, 6397 and 6809 (M55) have been obtained with the Anglo-Australian Telescope. The observations were made to test Sweigart and Mengel's [Astrophy S. J. 229, 624] theory of mixing of nuclearly-processed material to the star's surface, and to elucidate the relationship between primordial and evolutionary origins for the range in abundance within Omega Cen. The Omega Cen stars were chosen in two groups either side of the giant branch, covering the luminosity range where the onset of mixing was predicted to occur. Abundances of C, N, Fe and other heavy elements have been determined by fitting synthetic spectra, calculated from model atmospheres, to the observational data.

16349 **(RRK—87-14) Dipole anisotropy in the decaying-particle universe models with nonzero cosmological constant.** Tomita, Kenji; Sugiyama, Naoshi. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jul 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751999/JAW.

The ratio (PHI) of 4π times the velocity perturbations to the dipole moment of the galactic density perturbations is derived in decaying-particle universe models with nonzero cosmological constant in two cases : the first case of only massless daughter particles and the second case in which the daughter particles consist of a massless particle and a massive particle. For the various values of tau/sub d/ (= the decay time x the Hubble constant), the curves of constant PHI are shown in the (Ω/sub 0/, λ/sub 0/) diagram, and the allowable regions satisfying the observational relation PHI $\simeq$ 0.9 in it are examined. For a comparison the curves in the non-decay dust universe models also are shown.

16350 **(RRK—87-18) Wave function of a collapsing dust sphere inside the black hole horizon.** Nambu, Yasusada; Sasaki, Misao. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Aug 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752002/JAW.

We investigate the wave function of a collapsing dust sphere and the interior of the associated black hole. We first consider the wave function of purely vacuum black hole interior and discuss the relation to the corresponding classical solutions. Because of the vacuum nature, a mass scale which characterizes the black hole mass can only be introduced into the wave function by hand. Then to put a mass scale into the wave function in a natural manner, we consider a dust collapse model whose classical counterpart can be exactly solved. As a result, we obtain the wave function of the black hole interior with mass determined by the dust mass. However, we find that the wave function is meaningful only at WKB level due to the sharp boundary surface of the dust sphere.

16351 **(RRK—87-22) Classical behavior of a scalar field in the inflationary universe.** Sasaki, Misao; Nambu, Yasusada; Nakao, Ken-ichi. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Sep 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752004/JAW.

Extending the coarse-graining approach of Starobinsky, we formulate a theory to deal with the dynamics of a scalar field in inflationary universe models. We find a set of classical Langevin equations which describes the large scale behavior of the scalar field, provided that the coarse-grained size is greater than the effective compton wavelength of the scalar field. The corresponding Fokker-Planck equation is also derived which is defined on the phase space of the scalar field. We show that our theory is essentially equivalent to the one-loop field theory in de Sitter space and reduces to that of Starobinsky in a strong limit of the slow roll-over condition. Analysis of a simple Higgs potential model is done and the implications are discussed.

16352 **(UCRL—96536) From baryon number generation to the quark-hadron phase transition.** Snyderman, N. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 22p. (CONF-8708165—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003835/JAW.

From Symposium on the origin and distribution of elements; New Orleans, LA, USA (31 Aug 1987).

Between the temperature scale at which baryon number was generated and the temperature at which baryons and mesons formed, there were phase transitions associated with the Weinberg-Salam symmetry breaking, and perhaps with Peccei-Quinn symmetry breaking and supersymmetry breaking. Also, the quark-hadron phase transition may have taken place in the presence of cosmic strings. Some possible implications of these phase transitions and degrees of freedom on the evolution of the very early universe will be reviewed. 18 refs., 6 figs.

16353 **(UCRL—97745) Effects of galactic chemical evolution on thorium/neodymium cosmochronology.** Mathews, G.J.; Schramm, D.N. (Lawrence Livermore National Lab., CA (USA); Chicago Univ., IL (USA). Dept. of Astronomy and Astrophysics). Nov 1987. Contract W-7405-ENG-48. 17p. (CONF-8708165—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003829/JAW.

From Symposium on the origin and distribution of elements; New Orleans, LA, USA (31 Aug 1987).

We emphasize the importance of galactic chemical evolution and the different nucleosynthetic origins for thorium and neodymium with regards to the recent observations of neighboring spectral lines from these elements in G-Dwarfs stars and the use of the correlation of the spectral line ratio with stellar age to derive an upper limit to the age of the galaxy. When effects of galactic chemical evolution and nucleosynthetic origin are included the systematic trend in the data toward constant or even increasing Th/Nd ratio with stellar age can be easily understood. A model dependent (3σ) best upper limit of $T_0 \simeq 18$ Gyr to the age of the galaxy is derived, although simpler schematic models for the evolution of the Th/Nd ratio can give (3σ) upper limits ranging from 9 to 20 Gyr. 35 refs., 3 figs.

16354 **Uniqueness of the tunneling wave function of the Universe.** Vachaspati, T.; Vilenkin, A. (Bartol Research Institute, University of Delaware, Newark, Delaware 19716). *Physical Review [Section] D: Particles and Fields;* 37: No. 4, 898-903(15 Feb 1988).

The "tunneling" approach to quantum cosmology is applied to a perturbative superspace model in which the inhomogeneous modes of the gravitational and scalar fields are treated as linear perturbations. It is shown that in this approach the wave function of the Universe is uniquely determined by the boundary conditions. It describes a universe nucleating as a de Sitter space with quantum fields in de Sitter-invariant vacuum states.

16355 **Variation of the Fermi constant and primordial nucleosynthesis.** Dixit, V.V.; Sher, M. (Department of Science and Mathematics, Parks College of St. Louis University, Cahokia, Illinois 62206). *Physical Review [Section] D: Particles and Fields;* 37: No. 4, 1097-1098(15 Feb 1988).

Motivated by the dependence of the fundamental constants on the size of compact dimensions, Kolb, Perry, and Walker considered the effects on primordial nucleosynthesis of variations in some of these constants, including the Fermi constant G/sub F/. We note that, in the standard model, a variation in G/sub F/ will necessarily imply a variation in the vacuum expectation value of a Higgs field, which in turn will affect the electron mass, quark masses (and thus the neutron-proton mass difference), and the pion mass (and thus the binding energy of the deuteron). We calculate the effect on primordial nucleosynthesis of a variation in the vacuum expectation value of the Higgs field, including all of these factors.

16356 **On the detection of ultrahigh-energy neutrinos.** Reno, M.H.; Quigg, C. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields;* 37: No. 3, 657-664(1 Feb 1988).

Cross sections for the interactions of ultrahigh-energy neutrinos with nucleons are evaluated using contemporary information about nucleon structure functions. For 10/sup 19/-eV neutrinos, the cross section is an order of magnitude larger than the values traditionally used in astrophysical calculations. Some consequences for interaction rates in the Earth and for event rates in large-scale acoustic and electronic detectors from generic astrophysical neutrino sources are noted.

16357 **Neutron stars and the equation of state.** Cooperstein, J. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* 37: No. 2, 786-796(Feb 1988). Contract AC02-76CH00016.

The static properties of neutron stars are probed using phenomenological equations of state. These properties include the maximum mass, radii, central densities, and binding energies. It is found that quite different equations of state can produce similar neutron stars. Likewise, it is also found that equations of state which are quite similar near saturation density can produce very different neutron stars, since it is the high density behavior which is most important. Symmetric matter results cannot be used to uniquely constrain neutron matter because of model dependence on the symmetry energy.

16358 **Evidence for a scaling solution in cosmic-string evolution.** Bennett, D.P.; Bouchet, F.R. (NASA/Fermilab Astrophysics Center, Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Physical Review Letters;* 60: No. 4, 257-260(25 Jan 1988).

We study, by means of numerical simulations, the most fundamental issue of cosmic-string evolution: the existence of a scaling solution. We find strong evidence that a scaling solution does indeed exist. This justifies the main assumption on which the cosmic-string theories of galaxy formation are based. Our main conclusion coincides with that of Albrecht and Turok in previous work, but our results are not consistent with theirs. In fact, our results indicate that the details of string evolution are very different from the standard dogma.

16359 **Test of the weak equivalence principle for neutrinos and photons.** Krauss, L.M.; Tremaine, S. (Center for Theoretical Physics and Department of Astronomy, Yale University, New Haven, Connecticut 06520). *Physical Review Letters;* 60: No. 3, 176-177(18 Jan 1988).

The observation of a neutrino burst within 3 H of the associated optical burst from supernova 1987A in the Large Magellanic Cloud provides a new test of the weak equivalence principle, by demonstrating that neutrinos and photons follow the same trajectories in the gravitational field of the Galaxy. The accuracy of the test depends on the poorly known mass distribution in the outer parts of the Galaxy, but is at least 0.5% and probably much better. This result provides direct evidence that the Shapiro geodesic time delay is identical, to this accuracy, for different elementary particles, independent of spin and internal quantum numbers.

16360 **Bounds on light, weakly interacting particles from observational lifetimes of helium-burning stars.** Raffelt, G.G.; Dearborn, D.S.P. (Institute for Geophysics and Planetary Physics, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] D: Particles and Fields;* 37: No. 2, 549-551(15 Jan 1988). Contract W-7405-ENG-48.

The lifetimes of low-mass population I helium-burning stars as derived from the number of "clump" giants in the open cluster M67 and in the old galactic disk population agree very well with calculations. This provides an observational basis for previous speculative bounds on axions, Majorons, supersymmetric particles, and exotic scalar and vector bosons. We find a slightly improved bound on the neutrino magnetic dipole moment of $\mu/\text{sub } \nu/ < 3 \times 10/\text{sup } -11/\mu/\text{sub B}/$. The possibility of detecting axionlike particles in the laboratory is severely constrained.

16361 **Fields due to kinky, cuspless, cosmic loops.** Garfinkle, D.; Vachaspati, T. (Physics Department, University of Florida, Gainesville, Florida 32611). *Physical Review [Section] D: Particles and Fields;* 37: No. 2, 257-262(15 Jan 1988).

We study the gravitational field of a kinky, cuspless loop of cosmic string. The gravitational field does not have a repulsive component as in the case of loops with cusps and so the gravitational field produced by cuspless loops is spherically symmetric and Newtonian when we go far away from the loop. We also find the electromagnetic field due to kinks on a current-carrying superconducting cosmic loop and the Goldstone field produced by a loop of global string. For the case of the Goldstone field we also consider loops with cusps.

16362 **Bosonic superconducting cosmic strings.** Hill, C.T.; Hodges, H.M.; Turner, M.S. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields;* 37: No. 2, 263-282(15 Jan 1988).

We study the classical solutions of bosonic superconducting strings for quartic and Coleman-Weinberg effective potentials. We map the parameter space of solutions, and discuss and quantify back reaction of the charged condensate upon the vortex. We address the issue of the critical current and the quench transition. We consider static loop configurations in which electromagnetic stresses balance the loop string tension. Such static loops are shown to exist only in a very small region of the parameter space. We also give accurate results for the energy per length of a nonsuperconducting gauged string for arbitrary ratio of Higgs-boson to vector mass.

16363 **Kiloelectronvolt-era nucleosynthesis and its implications.** Dimopoulos, S.; Esmailzadeh, R.; Hall, L.J.; Starkman, G.D. (Department of Physics, Stanford University, Stanford, California 94305). *Physical Review Letters;* 60: No. 1, 7-10(4 Jan 1988).

A late-decaying particle, e.g., the gravitino, initiates a new phase of nucleosynthesis in the kiloelectronvolt era. The abundances of all light elements, except ^{4}He, are given by the fixed points of the rate equations, agree with observations, and are insensitive to the pre-kiloelectronvolt physics if ^{4}He is not underproduced. Constraints from ordinary nucleosynthesis evaporate, allowing a wide range of values for $\Omega/\text{sub B}/$ and the expansion rate: The Universe can be closed by baryons; the number of light ν species can be greater than four; the era of conventional nucleosynthesis can be matter or vacuum-energy dominated.

16364 **Possibility of shielding the fifth force.** Fischbach, E.; Kloor, H.T.; Talmadge, C.; Aronson, S.H.; Gillies, G.T. (Physics Department, Purdue University, West Lafayette, Indiana 47907). *Physical Review Letters;* 60: No. 1, 74-74(4 Jan 1988).

A Comment on the Letter by P. Boynton et al., Phys. Rev. Lett. 59, 1385 (1987).

16365 **Development of cascade showers in dense media.** Zachary, A.L. (Department of Astronomy, University of CaliforniaBerkeley, Berkeley, California 94720). *Physical Review [Section] D: Particles and Fields;* 37: No. 1, 112-121(1 Jan 1988).

I have discovered a new way of solving for the evolution of an electromagnetic cascade shower when the cross sections have been altered by the density. This method relies on a set of Green's-function solutions to the usual diffusion equations of approximation A of Rossi and Greisen. The Green's functions explicitly account for the energy and density dependence of the cross sections. This technique gives distribution functions for showers in material at any density, and for all incident and final energies. In particular, this method has been used to study the development of cascade showers at the surface of a neutron-star polar cap. Particles emitted by nuclei excited by a cascade shower are thought to be an important plasma source for radio pulsars. Showers computed using the density-suppressed cross sections penetrate much deeper than the usual

Bethe-Heitler showers, which reduces the importance of the excited nuclei for pulsar models. The integrated cross sections introduced by the Mellin-transform techniques of approximation A lend themselves to a description of shower evolution in terms of the mean shower properties. The solutions to the mean shower development equations are at best a rough guide to the evolution of the shower as a whole, but they clearly illustrate the increasing penetration depth of the shower caused by the reduced cross sections.

16366 **Kinetic study of solar wind mass loading and cometary bow shocks.** Omidi, N.; Winske, D. (Institute of Geophysics and Planetary Physics, University of California, Los Angeles). *Journal of Geophysical Research;* **92**: No. A12, 13409-13426(1 Dec 1987).

A detailed numerical study is conducted to understand the kinetic processes associated with solar wind mass loading due to pickup of cometary ions and the formation of cometary bow shocks. Because in this study we are most interested in phenomena which take place over time and spatial scales associated with ion dynamics, electrons are treated as a massless fluid. On the other hand, solar wind protons and heavy cometary ions are treated kinetically. It is found that solar wind deceleration and pickup of cometary ions take place through both the macroscopic electromagnetic fields embedded in the solar wind, as well as the microscopic fields associated with low-frequency electromagnetic waves that are generated by the unstable velocity distribution function of the cometary ions. These electromagnetic waves can grow to very large amplitudes and their nonlinear evolution is controlled by their wave normal angle. At parallel propagation where the waves are noncompressional, parametric instabilities seem to be operative, while the oblique, compressional waves are found to steepen and form shocklets. As for the nature of cometary bow shocks, three different regimes are found, based on the shock normal angle. For shock normal angles at or near 90° (quasi-perpendicular), a typically thin transition region (shock) is formed through steepening of fast magnetosonic pulses. This shock is a pure proton shock in that no sharp change in density or velocity of the cometary ions is observed across the shock. at intermediate shock normal angles (oblique), a much wider transition region is seen where the solar wind is gradually heated and decelerated.

16367 **Search for high-energy neutrinos from SN1987A: First six months.** Oyama, Y.; Hirata, K.; Kajita, T.; Koshiba, M.; Nakahata, M.; Sato, N.; Suzuki, A.; Takita, M.; Totsuka, Y.; Kifune, T.; and others. (International Center for Elementary Particle Physics, Department of Physics and Department of Astronomy, Faculty of Science, University of Tokyo, Tokyo 113, Japan). *Physical Review Letters;* **59**: No. 22, 2604-2606(30 Nov 1987).

A search was made for high-energy neutrinos from SN1987A. Specifically, upward-going muons with energy greater than 1.7 GeV produced in the nearby rock by neutrinos from SN1987A were searched for in a 2140-ton underground water Cherenkov detector, Kamiokande II. No upward-going muons from the direction of SN1987A were found within the time period between 23 February 1987 and 1 September 1987. The 90%-confidence-level flux limit of the upward-going muons from SN1987A is found to be 1.2 x 10/sup -13/ cm/sup -2/ s/sup -1/ for the energy threshold of 1.7 GeV. For neutrino energy greater than 1.7 GeV, limits on the SN1987A neutrino flux and luminosity are 2.4 x 10/sup -5/ cm/sup -2/ s/sup -1/ and 1.6 x 10/sup 41/ erg s/sup -1/ for a cutoff energy E/sub c/ = 10/sup 15/ eV and a spectral index γ = 2.1, and 2.3 x 10/sup -3/ cm/sup -2/ s/sup -1/ and 4.6 x 10/sup 42/ erg s/sup -1/ for E/sub c/ = 10/sup 12/ eV and γ = 2.7.

16368 **Eastward deflection of fast coronal mass ejecta in interplanetary space.** Gosling, J.T.; Thomsen, M.F.; Bame, S.J.; Zwickl, R.D. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **92**: No. A11, 12399-12406(1 Nov 1987).

Previous work has shown that a bidirectional solar wind electron heat flux is one of the more prominent signatures of a coronal mass ejection event in the solar wind at 1 AU. Using ISEE 3 solar wind electron measurements obtained during 1978 and 1979, we have used this signature to identify the fast coronal mass ejecta driving 19 interplanetary shocks. In 17 of the 19 shock events an eastward deflection of the ejection plasma (apparent arrival from west of the sun) was observed. The average eastward deflection for all of the events was ~3°, corresponding to a typical transverse velocity of ~25 km/s. Usually an oppositely directed (i.e., westward) flow deflection of comparable magnitude was observed within the compressed ambient plasma ahead of the ejecta. The sense of these deflections: first westward within the compressed ambient plasma and then eastward within the ejecta: is the same as is observed near the leading edges of quasi-stationary, corotating high speed streams. However, in contrast to the case of corotating streams, the west-east flow reversal does not coincide with a local maximum in static pressure. No consistent flow deflection pattern perpendicular to the ecliptic has been observed for these events, and no similar deflections have been observed for ejecta (bidirectional electron heat flux events) traveling at the same speed as or slower than the ambient plasma ahead. We suggest that the preferred eastward deflection of these fast coronal mass ejecta is a consequence of solar rotation and the spiral geometry of the ambient solar wind. copyright American Geophysical Union 1987

16369 **Baryogenesis at the MeV era.** Dimopoulos, S.; Hall, L.J. (Stanford Univ., CA, USA. Dept. of Physics; Lawrence Berkeley Lab., CA, USA). *Physics Letters [Section] B;* **196**: No. 2, 135-141(1 Oct 1987). Contract AC03-76SF00098.

The addition of a single operator to the minimal low-energy supergravity theory allows baryogenesis to occur at the end of inflation. The reheat temperature is between an MeV and GeV and there is no gravitino problem. The model can be tested by searching for baryon number violation in e/sup +/e/sup -/ collisions.

16370 **Steepened magnetosonic waves at comet Giacobini-Zinner.** Tsurutani, B.T.; Thorne, R.M.; Smith, E.J.; Gosling, J.T.; Matsumoto, H. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena). *Journal of Geophysical Research;* **92**: No. A10, 11074-11082(1 Oct 1987).

We examine intense hydromagnetic waves at comet Giacobini-Zinner to investigate the mode and direction of wave propagation and thereby provide important constraints on potential mechanisms for wave origin in the vicinity of the comet. The character of the wave polarization changes from basically elliptical far from the comet to almost linear followed by either a rapid partial rotation (less than 360°) or multiple rotations (high-frequency wave packets) in the vicinity of the bow wave. Simultaneous high-resolution measurements of electron density fluctuations demonstrate that the long-period (~100 s) waves are propagating in the magnetosonic (fast MHD) mode. Principal axis analyses of the long-period waves and accompanying partial rotations show that the sum of the wave phase rotations is 360°. This indicates that both are parts of the same wave.

16371 **Atmospheric neutrino fluxes at low energy.** Gaisser, T.K.; Stanev, T. (Bartol Research Foundation of the Franklin Institute, University of Delaware, Newark, DE 19716). *AIP (American Institute of Physics) Conference Proceedings;* **126**: No. 1, 277-282(25 Jan 1985). (CONF-8408132—).

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

With the exception of the high rate for the S-type single ring event Kamioka, which might have an easier experimental explanation, the observed rates of neutrino interactions is well understood and agrees with predictions based on the current knowledge of cosmic ray flux, particle interactions and geomagnetic field. (AIP)

16372 **Neutrinos from stellar collapse.** Burrows, A. (Department of Physics, State University of New York, Stony Brook, N.Y. 11794). *AIP (American Institute of Physics) Conference Proceedings;* **126**: No. 1, 283-294(25 Jan 1985). (CONF-8408132—).

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

Neutrinos produced during stellar collapse are discussed. The neutrino signature in the standard model is sketched and the

detectibility of the integrated neutrino flux and neutrino detectors are also discussed. The hydrodynamics of collapse and the subsequent shock waves that are produced are discussed in relation to the neutrino production. (AIP)

16373 **Chlorine solar neutrino experiment.** Rowley, J.K.; Cleveland, B.T.; Davis R. Jr. (Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings;* **126**: No. 1, 1-21(25 Jan 1985). (CONF-8408132—). Contract AC02-76CH00016.

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

The chlorine solar neutrino experiment in the Homestake Gold Mine is described and the results obtained with the chlorine detector over the last fourteen years are summarized and discussed. Background processes producing ^{37}Ar and the question of the constancy of the production rate of ^{37}Ar are given special emphasis.

16374 **Constraints of observations of solar oscillations on solar models with mixing by turbulent diffusion.** Cox, A.N.; Kidman, R.B.; Newman, M.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **126**: No. 1, 93-99(25 Jan 1985). (CONF-8408132—).

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

The pulsational behavior of solar models with mixing produced by turbulent diffusion has been investigated, for both p (pressure) modes and g (gravity) modes. It is found that while a small amount of mixing may be allowed by the observed data on solar oscillations, values of the pseudo-Reynolds number large enough to reduce the predicted neutrino counting rate to the level seen by the ^{37}Cl experiment are in conflict with published solar oscillation data.

16375 **Proposed solar neutrino experiment using $^{81}Br(\nu,e^-)^{81}Kr$.** Hurst, G.S.; Chen, C.H.; Kramer, S.D.; Allman, S.L. (Oak Ridge National Laboratory, Oak Ridge, TN 37831). *AIP (American Institute of Physics) Conference Proceedings;* **126**: No. 1, 152-161(25 Jan 1985). (CONF-8408132—). Contract AC05-84OR21400.

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

It has now been show that it is feasible to measure the ^{7}Be neutrino source in the sun by using the reaction $^{81}Br(\nu,e^-)^{81}Kr$ in a radiochemical experiment. Such an experiment would be quite similar to the Davis, Cleveland, and Rowley method for measuring the ^{8}B neutrino using $^{37}Cl(\nu,e^-)^{37}Ar$ except that the resonance ionization spectroscopy (RIS) method (instead of decay counting) would be employed to count the 2×10^5-yr ^{81}Kr atoms.

16376 **/sup 163/Dy as a solar neutrino detector.** Bennett, C.L. (Lawrence Livermore National Laboratory, Livermore, California). *AIP (American Institute of Physics) Conference Proceedings;* **126**: No. 1, 212-215(25 Jan 1985). (CONF-8408132—). Contract W-7405-ENG-48.

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

The possibility of using /sup 163/Dy as a low threshold solar neutrino detector is discussed. Solar neutrino absorption cross sections are calculated and expected capture rates presented.

16377 **Some effects of high temperature and density on neutron-capture nucleosynthesis.** Norman, E.B.; Kellogg, S.E. (Nuclear Physics Laboratory, University of Washington, Seattle, WA 98195). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 753-765(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Examples of nuclear reactions between nuclei in excited states, beta decays of nuclear excited states, and bound-state beta decays are shown. The effects of these processes on selected problems in heavy-element nucleosynthesis are discussed.

16378 **Dynamic stellar neutron capture nucleosynthesis: The need for more nuclear data for the s-process.** Mathews, G.J.; Howard, W.M.; Takahashi, K.; Ward, R.A. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 766-773(15 Jan 1985). (CONF-840906—). Contract W-7405-ENG-48.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

We summarize results from a detailed parameter study of the s-process in models which produce an exponential distribution of exposures by sequential irradiations and dredge up in the stellar environment. The calculations are based on a complete network of measured and calculated neutron capture and beta-decay rates as well as estimates for their temperature dependence. In the framework of these models we identify and systematically vary the astrophysical variables which affect the observed solar-system σN (cross section times abundance) curve. Constraints are placed on the s-process neutron exposure and flux as well as the temperatures, densities, neutron pulse shape and inter-pulse period. The results also highlight important needs for better nuclear data in various mass regions.

16379 **On the structure of astrophysical magnetic fields.** Rosner, R. (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA 02138). pp 328-336 of Twenty years of plasma physics. Mc Namara, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-840932—).

From Meeting on plasma physics; Trieste, Italy (24 Sep 1984).

Astrophysics has traditionally served as a major intellectual arena for magnetohydrodynamics; indeed much of the early work in MHD was carried out in the astrophysical context. In this work the author describes work carried out recently at Harvard which addresses astrophysical problems which are of great currency. Specifically, he focuses on the problem of how magnetic fields in nature manage to structure themselves spatially in the absence of wires or other current-carrying devices which are at our disposal to control.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 15953, 16660

16380 **(AD-A—185471/0/XAB) Nature and the nonlinear evolution of electrostatic waves associated with the AMPTE (Active Magnetosphere Particle Tracer Explorers) solar-wind releases. Progress report.** Omidi, N.; Akimoto, K.; Gurnett, D.A.; Anderson, R.R. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jul 1987. 54p. NTIS, PC A04/MF A01.

The nonlinear evolution of the electrostatic waves observed during the AMPTE (Active Magnetosphere Particle Tracer Explorers) solar-wind releases is investigated. Previous linear studies indicate two distinct sets of instabilities may be responsible for the generation. One set consists of ion-acoustic type instabilities insensitive to the presence of a background magnetic field, while the other group corresponds to the modified two-stream instabilities and requires the solar-wind flow to be across the ambient magnetic field. To establish which set of instabilities are more viable a detailed linear Vlasov theory has been conducted by numerically solving the full electromagnetic dispersion relation. In addition, both the plasma wave as well as the magnetic-field measurements by the IRM (Ion Release Module) spacecraft were used to correlate the frequency and the power of the observed waves with the magnitude and the direction of the solar-wind magnetic field. The results of these analyses indicate that the ion-acoustic type instabilities have growth rates that are an order of magnitude or more larger than those of the modified two-stream instabilities. The results show that both the solar-wind protons and the released ions may be heated and accelerated in the directions oblique to the solar-wind flow velocity.

16381 **(AD-A—185534/5/XAB) Observations of very-high-latitude ionospheric irregularities with the Goose Bay HF (high frequency) radar.** Greenwald, R.A.; Baker, K.B. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 7 Jun 1985. 19p. NTIS, PC A03/MF A01.

Pub. in Conference Proceedings on Propagation Effects on Military Systems in the High Latitude Region, 4.5.1-4.5.17(3-7 Jun 1985), rept. no. AGARD-CP-382.

The Goose Bay HF radar is a sophisticated instrument capable of providing detailed information on very-high-latitude E- and F-region ionospheric electron-density irregularities which act as a source of clutter on OTH radar systems. Through the use of two parallel phased-array antennas, this instrument is able to image the location of these irregularities within a three-dimensional volume covering much of northeastern Canada and Greenland. It is also capable of following the temporal variability of these irregularities as well as determining unambiguously the Doppler shift and broadening of radar signals scattered by them. This paper presents initial results with a single phased-array antenna, which represent typical examples of the spatial intensity distribution of these irregularities at different local times. Examples are presented of Doppler spectra of the irregularities at different local times. Data of this type are of appreciable value in ascertaining the techniques that must be utilized to improve clutter mitigation on high-latitude radar systems.

16382 **(AD-A—185748/1/XAB) Integrated systems with applications to the multi-phases of the ephemerides, physics and methematics of the upper atmosphere. Final report, June 1983-February 1987.** Bass, J.N.; Bhavnani, K.H.; Bonito, N.A.; Bryant, C.M.; McNEil, W.J. (Radex, Inc., Carlisle, MA (USA)). 27 Feb 1987. 231p. (RX—870227). NTIS, PC A11/MF A01.

This contract provided research, analysis and development support for integrated systems with applications to ephemerides, physics, and mathematics of the upper atmosphere. Investigations were supported in various aspects of neutral atmospheric density, ionospheric scintillation, magnetic field models, magnetospherically trapped particles and auroral-particle precipitation. Software systems have been developed for processing and analyzing data pertaining to these research areas, and for interactive targeting of the space shuttle, ephemeris computation during double thrust, and processing of celestial aspect sensor data.

16383 **(AD-A—185794/5/XAB) Global convection patterns in the high latitude. Technical report (Final), 4 March 1983-31 December 1986.** Heelis, R.A. (Texas Univ., Richardson (USA). Center for Space Sciences). Feb 1987. 23p. NTIS, PC A03/MF A01.

Studies of large- and small-scale structures in the high-latitude F-region plasma velocity and concentration were undertaken. The large-scale plasma convection pattern was examined using an extensive satellite data base to reveal a major dependence of the dayside configuration of the pattern on the y-component of the interplanetary magnetic field. A model was constructed for periods of southward IMF much smaller scale structure is seen to dominate the observations. A smaller scale convection pattern has been tentatively identified in the data for northward IMF. Of primary importance, however, is the existence of small scale structure associated with sun-aligned arcs that have dimensions in the noon-midnight-direction that exceed those in the dawn-dusk direction by a factor of 10. In addition to these properties of the convection pattern the formation of E-region structure by the presence of structure in the F region was also examined.

16384 **(DOE/ER/13530—1) A study of the magnetic field annihilation process in the magnetosphere and some geotechnical applications: Summary progress report and projected work, August 1, 1986-July 31, 1987.** Akasofu, S.I.; Lee, L.C. (Alaska Univ., Fairbanks (USA). Geophysical Inst.). May 1987. Contract FG06-86ER13530. 5p. (GI—86-51b). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004165/JAW.

In the past year, we made progress in the understanding of the multiple X-line reconnection process and the global multiple X-line reconnection at the dayside magnetopause. We also studied the plasma instabilities associated with the current sheets at the magnetopause and in the magnetotail. In addition, a new and efficient mechanism for the ion heating across a quasi-perpendicular shock was proposed.

16385 **(UCRL—53806) Energetic particle drift motions in the outer dayside magnetosphere.** Buck, R.M. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 211p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88005097/JAW.

Models of the geomagnetic field predict that within a distance of approximately one earth radius inside the dayside magnetopause, magnetic fields produced by the Chapman-Ferraro magnetopause currents create high-latitude minimum-B "pockets" in the geomagnetic field. Drift-shell branching caused by the minimum-B pockets is analyzed and interpreted in terms of an adiabatic shell branching and rejoining process. We examine the shell-branching process for a static field in detail, using the Choe-Beard 1974 magnetospheric magnetic field model. We find that shell branching annd rejoining conserves the particle mirror field B/sub M/, the fieldline integral invariant I, and the directional electron flux j. We determine the spatial extent of the stable trapping regions for the Choe-Beard model. We develop an adiabatic branching map methodology which completely identifies and describes the location of shell-branching points and the adiabatic trajectories of particles on branched shells, for any model field. We employ the map to develop synthetic pitch angle distributions near the dayside magnetopause by adiabatically transforming observed midnight distributions to the dayside. We find that outer dayside lines contain particles moving on branched and unbranched shells, giving rise to distinctive pitch angle distribution features. We find a good correlation between the pitch angles which mark the transition from branched to unbranched shells in the model, and the distinctive features of the OGO-5 distributions. In the morning sector, we observe large flux changes at critical pitch angles which correspond to B-pocket edges in the model. Measurements on inbound passes in the afternoon sector show first the adiabatic particle shadow, then the arrival of fluxes on rejoined shells, then fluxes on unbranced shells - in accord with model predictions. 204 refs., 138 figs., 2 tabs.

16386 **Observations of polar rain at low and high altitudes.** Baker, D.N.; Bame, S.J.; Gosling, J.T.; Gussenhoven, M.S. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* 92: No. A12, 13547-13560(1 Dec 1987).

Observations in the distant magnetotail lobes (rapprox. >100 R/sub E/)= reveal that electrons in the ~50- to 1000-eV energy range often exhibit strong, field-aligned bidirectional anisotropies. Because of large tail motions in the variable flow of the solar wind, ISEE 3 data provide extensive sampling of most tail plasma regions in rapid succession. It is found that bidirectional electron fluxes occur predominantly in the lobe connected directly to the sunward interplanetary magnetic field in the open magnetosphere model (north lobe for away sectors and south lobe for toward sectors). Using data from the low-altitude DMSP spacecraft, we compare polar rain electron intensities, energy spectra, and time variations at low altitudes with concurrent bidirectional electron properties measured by ISEE 3. The field-aligned lobe electron phase space densities above ~200 eV agree well (i.e., to within a factor of ~2—3) with DMSP-measured polar rain phase space densities near the polar cap. Furthermore, the spectral slopes above 200 eV also are similar at low and high altitudes. Below 100—200 eV there is a thermal electron population in the distant tail, probably arising from local entry of plasma through the distant magnetopause, which is not present at DMSP altitudes. These data suggest that the suprathermal tail lobe electrons are essentially a test particle population which can move freely along field lines to form polar rain; in contrast, the thermal electrons are bound to the tailward flowing lobe ion population far down the tail and thus cannot reach the polar cap regions. copyright American Geophysical Union 1987

16387 **Ion and electron velocity distributions within flux transfer events.** Thomsen, M.F.; Stansberry, J.A.; Bame, S.J.; Fuselier, S.A.; Gosling, J.T. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* 92: No. A11, 12127-12136(1 Nov 1987).

The detailed nature of the thermal and suprathermal ion and electron distributions within magnetic flux transfer events (FTEs) is examined. Examples of both magnetosheath FTEs and magnetospheric FTEs are discussed. The detailed distributions confirm that FTEs contain a mixture of magnetosheath and magnetospheric plasmas. To lowest order, the distributions are consistent with a simple superposition of the two interpenetrating populations, with no strong interactions between them. To first order, some interesting differences appear, especially in the electron distributions, suggesting that considerable pitch angle scattering and some electron energy diffusion are also occurring. These observations should provide a useful test of analytical and numerical studies of interpenetrating plasmas. copyright American Geophysical Union 1987

16388 **Quantitative analysis of thermal (~1 eV) ion data from magnetospheric spacecraft.** Young, D.T.; Farrugia, C.J. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* 92: No. A11, 12307-12318(1 Nov 1987).

Predictions of expected count rates from ion collectors with circular openings having half acceptance angles of 16° and 45° are compared for the two extreme cases of (1) a Laplace field and (2) one in which the potential drop between the spacecraft surface and the plasma occurs in a sheath of infinitesimal spatial extent. It is found that for the narrower field of view (16°) and typical values of the spacecraft potential in the plasmasphere, the predictions are nearly identical in both cases and agree with observed ion data. However, the two cases increasingly deviate as the instrument field of view is made wider. This conclusion, derived here for arbitrary ion Mach numbers and finite Mach angles, applies to particle analysis based on both the retarding potential method as well as on the spin modulation method. We also argue that the method of obtaining plasma parameters (N and T) by analysis of spin-modulated fluxes has several advantages over retarding potential analysis. In the case of narrow aperture instruments, a simple formula for the integral ion flux is put forward, suitable for rapid processing of spin modulated data. It reduces in the appropriate limits to well-known analytic formulas. Applications to the European Space Agency (ESA) ESA/GEOS 1 ion composition data are included. copyright American Geophysical Union 1987

16389 **Electron/ion whistler instabilities and magnetic noise bursts.** Akimoto, K.; Gary, S.P.; Omidi, N. (Earth and Space Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* 92: No. A10, 11209-11214(1 Oct 1987).

Two whistler instabilities are investigated by means of the linear Vlasov dispersion equation. They are called the electron/ion parallel and oblique whistler instabilities and are driven by electron/ion relative drifts along the magnetic field. We demonstrate that the enhanced fluctuations from these instabilities can explain several properties of magnetic noise bursts in and near the plasma sheet in the presence of ion beams and/or field-aligned currents. At sufficiently high plasma β these instabilities may affect the current system in the magnetotail. copyright American Geophysical Union 1987

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 15057, 15178, 15179, 15347, 15441, 15595, 16552, 16779, 16971, 16994, 17183, 17201, 17202, 17383, 17389, 17398

16390 **(AD-A—185461/1/XAB) Interaction of radiation with matter: atomic collision processes occurring in the presence of radiation fields. Final report, 1 August 1977-31 July 1987.** Berman, P.R. (New York Univ., NY (USA). Dept. of Physics). 15 Sep 1986. 19p. NTIS, PC A03/MF A01.

Work is summarized in areas of: Laser-Assisted Collisions; Velocity Changing Collisions in Atomic Vapors; Coherent Transients; Collision-Induced Extra Resonances; Breakdown of the Optical Bloch Equations; Saturation Spectroscopy; Dynamics of Two- and Three-level Atoms Interacting with Radiation Fields; and Pulse Propagation.

16391 **(AD-A—185686/3/XAB) Photoionization of atoms and ions: application of time-dependent response method within the density functional theory. Interim report.** Gupta, U.; Davis, J.; Blaha, M. (Naval Research Lab., Washington, DC (USA)). 13 Oct 1987. 40p. (NRL-MR—6089). NTIS, PC A03/MF A01.

The photoionization cross section of several atoms (Ar, Xe, Rn, Cs) and ions (Ne-like Ar, H-like and Li-like C) of experimental interest are calculated using the time-dependent response scheme within the framework of local density functional method (DFM). The cross sections for rare-gas atoms calculated using this method agree very well with the experimental data; whereas conventional independent-particle model calculations do not. The polarization effect of the atom brought about by the incident time-varying radiation field is shown to be important in describing observed results. Unlike the independent-particle model, this effect effect is treated adequately in the DFM. To study the effect, plasma density and temperature on the photoionization cross section, calculations were also done for the ions mentioned above at various densities and temperatures. For computational simplicity, a simplified model of self-consistent finite-temperature DFM was used in which the long range part of the ionic potential was taken as the Debye-screened potential. These calculations were compared with the isolated ion calculations (without any plasma effect). With increasing plasma density, significant shifts of the ionization threshold as well as substantial modifications of photoionization cross section are obtained. This points out the need for incorporating the effect of surrounding plasma in realistic modeling of atomic properties for dense plasmas.

16392 **(AERE-R—12674) Angular and mass resolved energy distribution measurements with a gallium liquid metal ion source.** Marriott, P. (Salford Univ. (UK)). Jun 1987. 347p. NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750339/JAW.

Ionisation and energy broadening mechanisms relevant to liquid metal ion sources are discussed. A review of experimental results giving a picture of source operation and a discussion of the emission mechanisms thought to occur for the ionic species and droplets emitted is presented. Further work is suggested by this review and an analysis system for angular and mass resolved energy distribution measurements of liquid metal ion source beams has been constructed. The energy analyser has been calibrated and a series of measurements, both on and off the beam axis, of $^{69}Ga^{+}$, Ga^{++} and Ga_2^{+} ions emitted at various currents from a gallium source has been performed. A comparison is made between these results and published work where possible, and the results are discussed with the aim of determining the emission and energy spread mechanisms operating in the gallium liquid metal ion source.

16393 **(BNL—40508) Research with stored ions produced using synchrotron radiation.** Church, D.A.; Kravis, S.D.; Meron, M.; Johnson, B.M.; Jones, K.W.; Sellin, I.A.; O, C.S.; Levin, J.C.; Short, R.T. (Brookhaven National Lab., Upton, NY (USA); Texas A and M Univ., College Station (USA). Dept. of Physics; Tennessee Univ., Knoxville (USA). Dept. of Physics; Oak Ridge National Lab., TN (USA)). 1987. Contract AC02-76CH00016. 10p. (CONF-8708164—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004106/JAW.

From International conference on spectroscopy and structure of highly ionized atoms; Lisle, IL, USA (17 Aug 1987).

A distribution of argon ion charge states has been produced by inner shell photoionization of argon atoms using x-ray synchrotron radiation. These ions were stored in a Penning ion trap at moderate to very low well depths, and analog-detected yielding narrow charge-to-mass spectrum linewidths. Estimates of ion densities indicated that ion-ion collisional energy transfer should be rapid, leading to thermalization. Measurements using variants of this novel stored, multi-charged ion gas are considered.

16394 (BNL—40691) Energy transfer studies with lasers. Weston, R.E. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-871147—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004864/JAW.

From 3. international laser science conference; Atlantic City, NJ, USA (1 Nov 1987).

Using pulsed lasers to produce energetic species, we have observed their interaction with other molecules in real time by absorption spectroscopy with a c-w infrared diode laser. This technique has been used to observe the vibrational excitation of carbon dioxide by energy transfer from azulene and azulene-d_8 excited to energies of 30,000 and 40,000 cm^{-1}, and the relative populations of the bending and antisymmetric stretching modes of CO_2 are found to be very nonstatistical. Diode laser spectroscopy of CO has also been utilized to determine the efficiency of energy transfer from $O(^1D)$ atoms to vibrations of CO excited to $v = 1$ through 4. 11 refs., 1 fig., 1 tab.

16395 (CEA-CONF—9121) Study of the multiple exchange frequencies in bcc /sup 3/He by thermodynamic measurements. Bernier, M.; Suaudeau, E.; Roger, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). Aug 1987. 3p. (CONF-870873—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751355/JAW.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

To study the multiple exchange hamiltonian of solid /sup 3/He we measured the contribution of the spin exchange to the pressure of bcc solid in various magnetic fields ($O \leqq H \leqq 7.5T$). Due to the nature of the atomic exchange of a fermion system this contribution is a strong function of the spin polarization. The characteristic frequencies of the exchange hamiltonian are obtained by fitting the pressure measurements with the results of a statistical calculation using a high temperature series expansion of the hamiltonian in a temperature range where both the magnetic effect is significant and the expansion converges ($7mK < T < 30mK$). We discuss the results obtained for two molar volumes.

16396 (CEA-CONF—9124) High temperature series expansions with a multiple-exchange Hamiltonian for the bcc and hcp phases of solid /sup 3/He. Roger, M.; Suaudeau, E.; Bernier, M.E.R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). Aug 1987. 3p. (CONF-870873—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751356/JAW.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

High temperature series expansions with a multiple-exchange Hamiltonian are performed to fourth order in arbitrary magnetic field for both phases of solid /sup 3/He. The susceptibility series are analysed with Pade approximants and compared with recent experimental results. For the hcp phase we estimate the ferromagnetic ordering temperature from susceptibility series and discuss the influence of four-particle exchange in lowering the transition.

16397 (CEA-CONF—9125) Three-particle exchange: a possible interpretation of ferromagnetism in adsorbed /sup 3/He. Roger, M.; Delrieu, J.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). Aug 1987. 3p. (CONF-870873—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751357/JAW.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

The recent observation of the onset of ferromagnetism for 2.2 /sup 3/He layers adsorbed on grafoil with a maximum effect for 2.5 layers is interpreted as a consequence of three particle exchange.

16398 (CLM-R—270) Atomic and molecular data for fusion. Part 2. Recommended cross sections and rates for electron ionisation of atoms and ions: fluorine to nickel. Lennon, M.A.; Bell, K.L.; Gilbody, H.B.; Hughes, J.G.; Kingston, A.E.; Murray, M.J.; Smith, F.J. (UKAEA Culham Lab., Abingdon). Aug 1986. 331p. H.M. Stationery Office, London, price Pound 10.00.

Experimental and theoretical cross section data for electron impact ionisation of atoms and ions from fluorine to nickel have been assessed. Based on this assessment and, in the absence of any data, on the classical scaling laws, a recommended cross section has been produced for each species. This has been used to evaluate recommended Maxwellian rate coefficients over a wide range of temperatures. Convenient analytic expressions have been obtained for the recommended cross sections and rate coefficients. The data are presented in both graphical and tabular form and estimates of the reliability of the recommended data are given.

16399 (CONF-871147—2) Two-photon (vuv and visible) resonant ionization spectroscopy of atoms and molecules. McCann, M.P.; Chen, C.H.; Payne, M.G. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004332/JAW.

From 3. international laser science conference; Atlantic City, NJ, USA (1 Nov 1987).

Two photon spectroscopy of argon, krypton and molecular hydrogen is considered in this paper. Experimental transition energies and two-photon rate constants are given. 4 refs., 1 tab. (LSP)

16400 (CONF-871147—3) High-order multiphoton ionization photoelectron spectroscopy of NO. Carman, H.S. Jr.; Compton, R.N. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004482/JAW.

From 3. international laser science conference; Atlantic City, NJ, USA (1 Nov 1987).

Photoelectron energy angular distributions of NO following three different high-order multiphoton ionization (MPI) schemes have been measured. The 3 + 3 resonantly enhanced multiphoton ionization (REMPI) via the $A^2\Sigma^+$ (v=O) level yielded a distribution of electron energies corresponding to all accessible vibrational levels (v^+ =O-6) of the nascent ion. Angular distributions of electrons corresponding to $v^+ = O$ and $v^+ = 3$ were significantly different. The 3 + 2 REMPI via the $A^2\Sigma^+$ (v=1) level produced only one low-energy electron peak ($v^+ = 1$). Nonresonant MPI at 532 nm yielded a distribution of electron energies corresponding to both four- and five-photon ionization. Prominent peaks in the five-photon photoelectron spectrum (PES) suggest contributions from near-resonant states at the three-photon level. 4 refs., 3 figs.

16401 (CONF-8705246—1) Reactive quenching of two-photon excited xenon atoms by Cl_2. Bruce, M.R.; Layne, W.B.; Meyer, E.; Keto, J.W. (Texas Univ., Austin (USA). Dept. of Physics). 1987. Contract FG05-84ER13191. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004550/JAW.

From 18. American Physical Society meeting on atomic molecular and optical physics; Boston, MA, USA (1 May 1987).

Total binary and tertiary quench rates have been measured for the reaction Xe ($5p^56p$) + Cl_2 at thermal temperatures. Xenon atoms are excited by state-selective, two-photon absorption with a uv laser. The time dependent fluorescence from the excited atom in the IR and from $XeCl^*$ (B) product near 308 nm have been measured with subnanosecond time resolution. The decay rates are measured as a function of Cl_2 pressure to 20 Torr and Xe pressure to 400 Torr. The measured reaction rates ($k_2 \sim 10^{-9}\ cm^3 sec^{-1}$) are consistent with a harpoon model described in a separate paper. We also measure large termolecular reaction rates for collisions with xenon atoms ($k_3 \sim 10^{-30}\ cm^6 sec^{-1}$). Total product fluorescence has been examined using a gated optical multichannel analyzer. We measure unit branching fractions for high vibrational levels of $XeCl^*$ (B) with very little C state fluorescence observed. The measured termolecular rates suggest similar processes will dominate at the high buffer-gas pressures used in XeCl lasers. The effect of

these large reactive cross sections for neutral xenon atoms on models of the XeCl laser will be discussed.

16402 **(CONF-8705246—2) A multichannel harpoon model for reactive quenching of Xe $5p^5 6p$ by Cl_2.** Bruce, M.R.; Layne, W.B.; Keto, J.W. (Texas Univ., Austin (USA). Dept. of Physics). 1987. Contract FG05-84ER13191. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004263/JAW.

From 18. American Physical Society meeting on atomic molecular and optical physics; Boston, MA, USA (1 May 1987).

A harpoon reaction model employing multiple crossings based on the formalism of Bauer et al and Gislason and Sachs is developed to explain the large cross sections ($\sigma \sim 400$ A^2) measured for the reaction Xe $5p^6 6p + Cl_2$. The model calculates the Landau-Zener transition probability for each intermediate ionic crossing with the covalent surface. The transition matrix elements are represented as a product of the electronic interaction (modeled by the empirical result of Olson et al) and a Frank-Condon factor for the $Cl_2 \rightarrow Cl_2^-$ transition. The model predicts near unit probability for a transition to the ionic surface for impact parameters less than 20 Bohr. Once transfer occurs, the pair is captured by dissociation of Cl_2^- to form XeCl. The large temperature dependence observed qualitatively in the experiments is explained by the increased cross section for vibrationally excited Cl_2. A simple model for orbiting collisions is used to estimate the effect of termolecular collisions.

16403 **(CTA-IEAV-NT—012/85) Hondo 15 program for calculation of molecule electronic structure: its adaptation to Cyber 170/750 system of IEAv and use manual.** Rosato, A.; Pinheiro, A.M.B.S.; Ornellas, F.R.; Roberto Neto, O. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 18 Nov 1985. 48p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700144/JAW.

The HONDO/5 program, herein described, performs a Hartree-Fock-Roothaan type calculation in molecules employing Gaussian type functions in the expansion of the molecular orbitals. After a brief exposition of the method upon which the theory is based, a new manual is presented in a more detailed version than the original one.

16404 **(DOE/ER/04971—8) Energy-related atomic and molecular structure and scattering studies: Final report.** (New York Univ., NY (USA)). 1987. Contract AC02-78ER04971. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004246/JAW.

The general goals of the DOE research concerned the use of molecular beams techniques in the study of atomic and molecular polarizabilities and the study of the interactions between electrons and highly polar molecules. Both of these goals are directly relevant to the general problem of the role played by long-range forces in atomic and molecular physics. Details related to this motivation can be found in the published literature. Here we will describe in general terms the work performed under DOE sponsorship in the atomic beams laboratory at NYU. Our original intent was to exploit techniques developed at NYU, mainly in the study of simple atomic systems, to the more complex atomic and molecular systems that are related to DOE interests. These included the developing understanding of the structure of molecular systems, particularly of alkali halide molecules, and the study of the interactions of electrons with such molecules. The structure experiments would serve as critical experimental benchmarks for computational techniques on molecular properties, including both molecular wave functions and derivative properties of them, such as vibrational and rotational constants, but in particular of molecular electric dipole polarizabilities. We believe that we have at least to some extent fulfilled these goals. 16 refs., 1 fig.

16405 **(DOE/ER/10618—22) Theoretical studies of atomic transitions: Progress report, March 15, 1985-March 14, 1988.** Froese Fischer, C. (Vanderbilt Univ., Nashville, TN (USA)). Sep 1987. Contract AS05-80ER10618. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004719/JAW.

Allowed and forbidden transitions have been studied for a number of atomic systems of interest in astrophysics, laser physics, or fusion research. All calculations have been based on the multiconfiguration Hartree-Fock (MCHF) method extended to include relativistic corrections in the Breit-Pauli approximation. The computer codes for this atomic structure software package were transferred to the CRAY supercomputer and modified for more convenient computation. Techniques were developed to enhance the range of problems considered, by either increasing the accuracy of prediction or increasing the complexity of problems considered. An example is the prediction of a bound state for Ca^- for which experimental evidence was inconclusive. Several different types of problems have been considered. A study of energy levels and lifetimes of a Rydberg series can given insight into electronic structure and explain deviations from regular behavior, and a number of such studies were performed. With the MCHF + Breit-Pauli approach it has been possible to determine a large portion of a spectrum. In core excited quartets of Na, autoionization along spin-orbit mixing and term dependence were all important in predicting lifetimes in excellent agreement with the most recent experiments. Some photoionization studies were performed which, like autoionization require the calculation of continuum functions. Finally, an attempt was made to combine the MCHF method with many-body perturbation theory so as to build on the strengths of both. 13 refs., 2 figs., 3 tabs.

16406 **(DOE/ER/10676—10) Semiempirical studies of atomic structure: Final progress report, July 1, 1980-June 30, 1988.** Curtis, L.J. (Toledo Univ., OH (USA). Dept. of Physics and Astronomy). 15 Nov 1987. Contract AS05-80ER10676. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004096/JAW.

This paper discusses the following research: screening parameter studies of low lying strongly penetrating states, core polarization and penetration studies of Rydberg states, fast ion beam measurements, and calculational formulations. (LSP)

16407 **(DOE/ER/13488—2) Studies in finite time thermodynamics: Progress report, April 1, 1987-March 31, 1988.** Berry, R.S. (Chicago Univ., IL (USA)). Dec 1987. Contract FG02-86ER13488. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004531/JAW.

This paper briefly discusses work in prorress in the following areas: determination of optimal current paths for electrochemical systems, analysis of the production of entropy when beam of atoms is stopped by the absorption and reemission of laser light, the use of a variational method for the treatment of transport processes and related nonequilibrium states, and a cooperative effect to resolve the controversy concerning the use of various metrics in a space of thermodynamic variables. (LSP)

16408 **(DOE/ER/13515—3) State-to-state dynamics of molecular energy transfer: Annual performance report, April 1, 1987-March 31, 1988.** Gentry, W.R. (Minnesota Univ., Minneapolis (USA)). 16 Nov 1987. Contract FG02-86ER13515. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003282/JAW.

An overview is given for the study of pure rotational excitation in I_2 + He collisions, and experiments to explore the vibrational-rotational coupling which accompanies mode-selective vibrational excitation of polyatomic molecules.

16409 **(DOE/ER/13761—1) Nonlinear optics with broadband lasers: Progress report, July 15, 1987-April 14, 1988.** Raymer, M.G. (Rochester Univ., NY (USA). Inst. of Optics). Jan 1988. Contract FG02-87ER13761. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005026/JAW.

During this reporting period several important results were obtained on the fluctuation dynamics of both continuous-wave (cw) and pulsed dye lasers, as well as their effects in certain nonlinear optical processes: (1) A new method discovered for producing optical pulses with broad bandwidths (5 GHz) and smooth, slowly varying amplitude. The bandwidth is determined purely by phase fluctuations. (2) A theoretical treatment of pulsed dye lasers was

developed to explain intensity autocorrelation measurements. (3) The effects of laser bandwidth on the resonance fluorescence spectrum of a two-level atom were calculated. (4) The source of mode intensity fluctuations in a multimode, cw dye laser were shown, both experimentally and theoretically, to be caused by deterministic chaos, rather than quantum noise as had been previouly assumed in the literature.

16410 **(DOE/ER/45190—1) [Fundamental properties of spin-polarized quantum systems]: Technical progress report.** (Harvard Univ., Cambridge, MA (USA)). [1987]. Contract FG02-85ER45190. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004425/JAW.

This paper discusses the progress in the following areas: stability in ultra-high fields, resonant two-body recombination, microwave cooling of atomic hydrogen, three-body recombination on surfaces, hydrogen maser, parasitic helium-3 cooling, hydrogen condensed on helium surfaces, and cross beam scattering of hydrogen. 12 refs., 2 figs. (LSP)

16411 **(ECRC/M—2214) Plasma heat treatment using glow discharge electron beams.** Warren, P.H. (Electricity Council Research Centre, Capenhurst (UK)). Nov 1987. 10p. Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.

Early work on glow discharge electron beams demonstrated the possibility of this energy source being used for material processing and while the theoretical treatment of the process has been thoroughly researched and the process demonstrated in certain applications to the stage of building prototype equipment, its commercial exploitation has not been achieved. This paper describes work carried out at the Electricity Council Research Centre to examine possible applications of glow discharge electron beam heating and thermochemical treatment and emphasises specific attributes which result in its choice for the examples given. This work demonstrates that carburising and nitrocarburising using glow discharge electron beams produce similar results to plasma treatments while the glow discharge electron beam offers the possibility of selected area treatment.

16412 **(EFI—884(35)-86) X-ray absorption spectra theory in variable valency compounds.** Kocharyan, A.N. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700154/JAW.

A qualitative theory of X-ray L_3, M_4, M_5 absorption spectra in anomalous rare-earth compounds with variable valency is constructed, which explains a doublet X-ray absorption near edge structure (XANES). The model of electron structure suggested also describes well the character of variation in relative intensity of two resonance absorption peaks at valency change with pressure and temperature. 7 references, 2 figures.

16413 **(GSI—87-8) Inner-shell excitation in heavy ion collisions up to intermediate incident energies.** Reus, T. de. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). Fachbereich 13 Physik). Apr 1987. 254p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88751494/JAW.

Electronic excitations in collisions of very heavy ions with a total nuclear charge Z greater than $1/\alpha \simeq 137$ at bombarding energies reaching from 3.6 MeV/n up to 100 MeV/n are the subject of this thesis. The dynamical behaviour of the electron-positron-field is described within a semiclassical model, which is reviewed and extended to include electronic interactions via a mean field. A detailed comparison with experimental data of K-vacancy formation, δ-electron and positron emission shows an improved agreement compared with former calculations. Structures in spectra of positrons emitted in sub- and supercritical collision are discussed in two respects: Firstly as a signal of the vacuum decay in supercritical electromagnetic fields which evolve in the vicinity of long living giant nuclear molecules. Secondly as an atomic effect, which might be related to an instaneous formation of molecular $1s\sigma$- and 2p/sub 1/2/σ- levels. However, beyond this speculation the emission spectra of electrons and positrons in deep inelastic reactions have proven to be a powerful tool for measuring nuclear reaction or delay times in the order of 10/sup -21/s. This property was transfered to the domain of intermediate energy collisions. In first order perturbation theory we derived a scaling law, exhibiting how nuclear stopping times could be extracted from the emission spectra of high energetic δ-electrons. Quantitative calculations within a coupled channel code have been carried out for the system Pb+Pb, yielding cross sections of up to 20 nb for the emission of electrons with a kinetic energy of 50 MeV in 60 MeV/n-collisions. (orig./HSI).

16414 **(IFUSP-P—609) Dipole-dipole dispersion forces for small, intermediate and large distances.** Antonio, J.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Oct 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700186/JAW.

An improved expression is obtained for the dipole-dipole London dispersion force between closed shell atoms for small, intermediate and large distances compared with their linear dimensions.

16415 (INIS-BR—748, pp 29) **Spectrum of hydrogen molecule.** Fontenele, M.; Gallas, J.A.C. (Santa Catarina Univ., Florianopolis, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16416 (INIS-BR—748, pp 29) **Partition method and the complete Stark effect in hydrogen atoms.** Lograd o, P.G.; Vianna, J.D.M. (Brasilia Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16417 (INIS-BR—748, pp 29) **Diamagnetism in hydrogen atoms.** Rech, P.C.; Gallas, J.A.C.; Gallas, M.R. (Santa Catarina Univ., Florianopolis, Brazil; Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16418 (INIS-BR—748, pp 30) **Application of the discretized double generator coordinate method for the problem of a hydrogen atom in a superintense laser field.** Mohallen, J.R.; Trsic, M. (Minas Gerais Univ., Belo Horizonte, Brazil; Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16419 (INIS-BR—748, pp 30) **Correlation study in the helium atoms.** Gallas, M.R.; Fava, L.F.; Gallas, J.A.C. (Rio Grande do Sul Univ., Porto Alegre, Brazil; Santa Catarina Univ., Florianopolis, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16420 (INIS-BR—748, pp 31) **Calculation of molecular orbitals in cobalt complexes.** Silva, S.R.N. da; Vugman, N.V.; Mello, P.C. de. (Rio de Janeiro Univ., Brazil; Pontificia Univ. Catolica do Rio de Janeiro, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16421 (INIS-BR—748, pp 35) **Modification of multiple scattering method for studying of electron scattering by molecules: preliminary calculations for low energy electron elastic scattering by hydrogen molecules.** Mancera, M.C.C.F.A.; Machado, L.E. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16422 (INIS-BR—748, pp 37) **Electron - molecule collisions.** Brescansin, L.M.; Lima, M.A.P.; Mackoy, V.; Huo, W. (Universidade Estadual de Campinas, Brazil; A.A. Laboratory of Chemical Physics, Caltech, Pasadena, CA; Notre Dame Univ., IN). 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16423 (INIS-BR—910, pp 3) **2D-NMR of single and double helices of gramicidin A in membrane and solution.** Bystrov, V.F. (AN SSSR, Moscow. Inst. Bioorganicheskoj Khimii). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16424 (INIS-BR—910, pp 7) **New method for determination of macromolecular structures by NMR.** Jardetzky, O. (Stanford Univ., CA, USA. Magnetic Resonance Lab.). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16425 (INIS-BR—910, pp 15) **Some developments in NMR of oriented molecules.** Pines, A. (California Univ., Berkeley, USA. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16426 (INIS-BR—910, pp 22) **Effects of magnetic field induced orientation in NMR spectroscopy of biomolecules.** Bottner-By, A.A.; Dadok, J.; Skoglund, C.M.; Zijl, P.C.M. van; Bastiaan, E.; MacLean, C. (Carnegie-Mellon Univ., Pittsburg, PA, USA; Vrije Univ., Amsterdam, Netherlands). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16427 (INIS-BR—910, pp 22) **Modified inept experiments and relative sign determination.** Jakobsen, H.J.; Brey, W.S.; Plant, H.D. (Aarhus Univ., Denmark; Florida Univ., Gainesville, USA. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16428 (INIS-BR—910, pp 24) **Active-site structures of ATP-utilizing enzymes.** Ray, B.D.; Nageswara Rao, B.D. (Indiana Univ., Indianapolis, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16429 (INIS-BR—910, pp 39) **ESR in the heavy-fermion UPt/sub 3/ doped with Er and Gd.** Gandra, F.G.; Schultz, S.; Oseroff, S.; Maple, M.B.; Rossel, C.; Dalichaouch, Y.; Fisk, Z. (Universidade Estadual de Campinas, Brazil. Inst. de Fisica; Los Alamos National Lab., NM, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16430 (INIS-BR—910, pp 40) **Crystal field effects in the ESR spectra of rare-earth ions in intermediate valence (IV) compounds.** Venegas U, P.; Barberis, G.E. (Universidade Estadual de Campinas, Brazil). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16431 (INIS-BR—910, pp 40) **ESR of Gd/sup 3+/ ions in cubic laves phase hydrides.** Cante, M.V.; Suassuna, J.F. (Universidade Estadual de Campinas, Brazil. Inst. de Fisica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16432 (INIS-BR—910, pp 41) **ESR detection of a hydrogen superstructure in the ZrV/sub 2/H/sub 4/ hydride.** Cante, A.G.S.; Suassuna, J.F. (Universidade Estadual de Campinas, Brazil. Inst. de Fisica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16433 (INIS-BR—910, pp 72) **Variable temperature /sup 13/C and /sup 19/Si CPMAS NMR studies of a series of polysilanes.** Fleming, W.W.; Gobbi, G.C.; SooriyaKumaram, R.; Miller, R. (IBM Almaden Research Center, San Jose, CA, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16434 (INIS-BR—910, pp 73) **Additivity of Carbon-13 spin-lattice relaxation times.** Williamson, K.L.; Moulton, S.K.; Ryan, M.A.; Robertson, D.; Reo, N.V.; Stengle, T.R. (Mount Holyoke Coll., South Hadley, MA, USA; Wright State Univ., Dayton, OH, USA; Massachussetts Univ., Amherst, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16435 (INIS-BR—910, pp 74) **Through-space transmission of /sup 19/F-/sup 13/C couplings via an intermediate bond: an experimental and theoretical study.** Rae, I.D.; Diz, A.C.; Giribet, C.G.; Ruiz de Azua, M.C.; Contreras, R.H. (Monash Univ., Clayton, Australia. Dept. of Chemistry; Buenos Aires Univ., Argentina. Facultad de Ciencias Exactas y Naturales). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16436 (INIS-BR—910, pp 74) **Theoretical analysis of the orientational effect of the p lone-pair on 31P-13C couplings in 7 - phosphachloronorbornene.** Aucar, G.A.; Giribet, C.G.; Ruiz de Azua, M.C.; Diz, A.C.; Contreras, R.H. (Universidad Nacional del Nordeste, Corrientes, Argentina; Buenos Aires Univ., Argentina. Facultad de Ciencias Exactas y Naturales). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16437 (INIS-BR—910, pp 75) **Carbon-13 NMR spectra of substituted ENDO, ENDO-tetracyclo (6,2,1,1/sup 3/,/sup 6/,O/sup 2/,/sup 7/) dodecanes.** Leal, K.Z.; Seidl, P.R.; Costa, V.E.U. (Instituto Militar de Engenharia, Rio de Janeiro, Brazil; Universidade Federal Fluminense, Niteroi, Brazil. Inst. de Quimica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16438 (INIS-BR—910, pp 75) **Study of the benzenesulfonate ion in nematic lyotropic mesophases and micellar solutions.** Fujiwara, F.Y.; Custodio, A.R. (Universidade Estadual de Campinas, Brazil. Inst. de Quimica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16439 (INIS-BR—910, pp 76) **Syntheses and NMR-studies of some metal-phthalocyanine-tetra-(3and4)-cyclopropylsulphonamides.** Yahya, H.K.; Dawood, A.A. (Baghdad Univ., Iraq. Coll. of Science). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16440 (INIS-BR—910, pp 77) **/sup 13/C and /sup 6/Li line-shape analysis of carbon lithium bond exchange processes among organolithium clusters.** Fraenkel, G. (Ohio State Univ., Columbus, USA. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16441 (INIS-BR—910, pp 77) **/sup 13/C NMR of two novel natural hydroperoxidic diterpenes.** Roque, N.F.; Vilegas, W.; Moraes, M.P.L. de. (Sao Paulo Univ., Brazil. Inst. de Quimica; Mato Grosso Univ., Cuiaba, Brazil. Dept. de Quimica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16442 (INIS-BR—910, pp 78) **Proton and C-13 NMR study of 2-hydroxy substituted pyridines.** Kowalewski, D.G. de; Contreras, R.H.; Santos, C. de los; Frydman, B. (Buenos Aires Univ., Argentina. Dept. de Fisica; Buenos Aires Univ., Argentina. Facultad de Farmacia y Bioquimica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16443 (INIS-BR—910, pp 78) **Use of selective long range heteronuclear decoupling in the structure determination and C-13 NMR assignment of compounds containing unsatured molecular cores.** Villar, J.D.F.; Ayer, W.A. (Instituto Militar de Engenharia, Rio de Janeiro, Brazil; Alberta Univ., Edmonton, Canada. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16444 (INIS-BR—910, pp 79) **High resolution O-17 NMR and the chemistry of water monomers.** Mateescu, G.D.; Butenhof, K.J.; Benedikt, G.M.; Brescic, I. (Case Western Reserve Univ., Cleveland, OH, USA. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16445 (INIS-BR—910, pp 79) **Novel applications of double-quantum NMR spectroscopy.** Mateescu, G.D.; Igbal, M. (Case Western Reserve Univ., Cleveland, OH, USA. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16446 (INIS-BR—910, pp 80) **Characterization of Brazilian heavy petroleum fractions by NMR spectroscopy.** Menezes, S.M.C. de; Silva, A.J.R. da; Silva, E.M.B. da. (PETROBRAS, Rio de Janeiro, Brazil. Centro de Pesquisas; Rio de Janeiro Univ., Brazil). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16447 (INIS-BR—910, pp 80) **/sup 1/H NMR in petroleum geochemistry.** Menezes, S.M.C. de; Soldan, A.L.; Mello, L.A.M. de. (PETROBRAS, Rio de Janeiro, Brazil. Centro de Pesquisas). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16448 (INIS-BR—910, pp 84) **On the interaction of copper with tris (hydroxymethyl) amino methane.** Colombo, M.F.; Silva, L.A.; Nascimento, O.R.; Castellano, E.E.; Tabak, M. (UNESP, Sao Jose do Rio Preto, Brazil; Sao Paulo Univ., Sao Carlos, SP, Brazil. Inst. de Fisica e Quimica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16449 (INIS-BR—910, pp 88) **Solution structure of alternating A-T sequence DNA via phase-sensitive 2D NMR methods.** Suzuki, E.; Pattabiraman, N.; Zon, G.; James, T.L. (California Univ., San Francisco, USA. Dept. of Pharmaceutical Chemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16450 (INIS-BR—910, pp 88) **DNA self-association studied by NMR.** Wemmer, D.E. (California Univ., Berkeley, USA. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16451 (INIS-BR—910, pp 89) **Investigation of the active site of /sup 15/N histidyl labeled α-lytic protease upon inhibition with peptide boronic acids by /sup 15/N and proton magnetic resonance spectroscopy.** Bachovchin, W.W.; Wong, W.Y.L.; Farr-Jones, S.; Kettner, C.A.; Shenvi, A.B. (Tufts Univ., Boston, MA, USA. Dept. of Biochemistry; E.I. Dupont de Nemours and Co., Wilmington, DE, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16452 (INIS-BR—910, pp 89) **Inhibition of elastase by peptide boronic acids examinate by lowfield proton magnetic resonance spectroscopy.** Farr-Jones, S.; Bachovchin, W.W.; Kettner, C.A.; Shenvi, A.B. (Tufts Univ., Boston, MA, USA. Dept. of Biochemistry; E.I. Dupont de nemours and Co., Wilmington, DE, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16453 (INIS-BR—910, pp 90) **Direct comparisons of the dynamics of the structural and membrane bound forms of filamentous bacteriophage coat protein.** Colnago, L.A.; Opella, S.J. (Instituto Militar de Engenharia, Rio de Janeiro, Brazil; Pennsylvania Univ., Philadelphia, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16454 (INIS-BR—910, pp 90) **Solid state /sup 14/N overtone NMR spectroscopy: principles and biophysical applications.** Tycko, R.; Opella, S.J. (National Institutes of Health, Bethesda, MD, USA; Pennsylvania Univ., Philadelphia, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16455 (INIS-BR—910, pp 91) **Interaction of (L-LYS-L-m/sup 5/TRP-L-LYS,L-LYS-D-m/sup 5/TRP-L-LYS) with d (CG-m/sup 5/CGCG). A 500 MHZ /sup 1/H-NMR study.** Neumann, J.M.; Huynh-Dinh, T.; Igolen, J.; Tran-Dinh, S. (CEA Centre d'Estudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France; Institut Pasteur, Paris, France). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16456 (INIS-BR—910, pp 92) **Conformational analysis by 500 MHZ /sup 1/H NMR of a retro-inverso cyclic somatostatin analog.** Tancredi, T.; Temussi, P.A.; Goodman, M.; Lucietto, P.; Motta, A. (Consiglio Nazionale delle Ricerche, Arco Felice, Italy; Naples Univ., Italy. Dipt. di Chimica; California Univ., San Diego, La Jolla, USA). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16457 (INIS-BR—910, pp 92) **Secondary structure of α-bungarotoxin in solution by /sup 1/H nuclear magnetic resonance.** Basus, V.J.; Billeter, M.; Kuntz, I.D.; Love, R.; Stroud, R. (California Univ., San Francisco, USA. Dept. of Pharmaceutical Chemistry; California Univ., San Francisco, USA. Dept. of Biochemistry and Biophysics). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

16458 (INIS-mf—11021) **Orientation, alignment and polarization in electron-helium collisions.** Beijers, J.P.M. (Rijksuniversiteit Utrecht (Netherlands)). 25 May 1987. 137p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700228/JAW.

In this thesis electron-photon coincidence experiments to study the excitation of helium by electron impact are updated. This is achieved by cross firing a well collimated and mono-energetic electron beam with a thermal helium beam and measuring the angular and/or polarisation distribution of the decay photons in coincidence with the inelastically scattered electrons. In this way target parameters are determined for the 2^1P, 3^1P, 3^1D and 3^3P states of helium. 75 references, 29 figures, 6 tables.

16459 (INIS-mf—11024) **Collisional redistribution of the Na-D lines in a Ne, Xe filled vapour cell and depolarization in a flame.** Nieuwesteeg, K.J.B.M. (Rijksuniversiteit Utrecht (Netherlands)). 6 Jan 1986. 170p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700231/JAW.

1. Measurements of collisionally perturbed, complete spectral profiles, i.e. core plus line wings of the Na-D lines, at the highest possible temperature in a fluorescence cell are reported. Both the shape of the profiles obtained in these experiments and the temperature dependence give information about the internuclear forces. Neon and xenon are chosen as perturbing atoms in order to extend and test potential shapes that have emerged from earlier beam experiments. 2. Possible ways are discussed of accurately calculating the cross sections of all elastic and inelastic processes in a Na-noble-gas system for any likely shape of the potentials involved. The main purpose of this discussion is to test these potentials by comparing the calculated cross sections with experimental data. Also a detailed comparison is made of the measured far-wing profile and the quasi-static profile calculated using these potentials. 3. In order to assess the validity of the approximations made in the theoretical model that was used for calculating the fluorescence-excitation profiles, the predictions of this model are compared with measurements of the polarization and the intensity ratio of the collision-induced Na-D fluorescence and Rayleigh scattering in an N_2-diluted flame at 1 atm pressure. Using the Utrecht High-resolution Fourier Interferometer in the visible range, the Rayleigh peak and the collision-induced fluorescence were separated for the first time at laser detunings within the absorption line width. 263 references, 41 figures, 14 tables.

16460 (INIS-mf—11093, pp 40-42) **Chemical effect on Tc 3d/sub 3/2/ core hole lifetime.** Koever, L.; Toth, J.; Cserny, I.; Fiser, M. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete; Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

The Tc 3d lines are often used for identification of various forms of technetium. The accuracy of the chemical analysis of Tc compounds is influenced by the Coster-Kronig broadening and by its dependence on the chemical state of Tc. The experiment reported used X-ray photoelectron spectroscopy to investigate the 3d core line widths obtained from spectra of Tc metal and of technetium-dioxide samples. A deconvolution algorithm was used for data evaluation. The results were compared with other experimental data. (D.Gy.). 4 refs.; 2 figs.

16461 (INIS-mf—11093, pp 27-29) **Projectile Z/v dependence of the multiple ionization of the Ne L-shell accompanying K-shell ionization in heavy-ion-atom collisions.** Berenyi, D.; Hock, G.; Kadar, I.; Ricz, S.; Sulik, B.; Varga, D.; Vegh, J. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

16462 (INIS-mf—11093, pp 30-32) **L/sub 3/-subshell alignment of argon following charge-changing collisions with protons.** Sarkadi, L.; Palinkas, J.; Koever, A.; Toekesi, K.; Gulyas, L.; Berenyi, D. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

There are two theoretical possibilities for the inner-shell vacancy production in ion-atom collisions: direct Coulomb ionization and the capture of inner-shell electron of the target atom by the projectile ion to a bound state. Theoretical calculations suggest considerably different alignments in the two cases. An experiment is performed to observe this difference of L/sub 3/ subshell alignments to Ar atoms following the collisions with proton projectiles. Preliminary results show a strong contradiction with the Oppenheimer-Brinkmann-Kramers approximation. (D.Gy.). 7 refs.

16463 (INIS-mf—11093, pp 33-34) **Shape of the 'cusp' in the spectrum of electron ejected into forward direction in ion-atom collisions.** Berenyi, D.; Gulyas, L.; Koever, A.; Szabo, Gy. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

16464 (INIS-mf—11093, pp 35) **Scattering correlation in double ionization of helium by fast antiprotons and protons.** Vegh, L. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

16465 (INIS-mf—11093, pp 36) **Coupled-states analysis of the heavy-ion induced L/sub 3/-subshell alignment.** Sarkadi, L. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

16466 (INIS-mf—11093, pp 37-38) **Experimental study of the effect of multiple ionization on the alignment of L/sub 3/-subshell vacancies.** Papp, T.; Palinkas, J. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

16467 (INIS-mf—11093, pp 39) **Stopping powers calculated by empirical electron-ejection cross sections.** Vegh, L. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

16468 (INIS-mf—11093) **ATOMKI Annual Report 1986.** Palinkas, J. (ed.). (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. vp. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

Research for 1986 is reported for ATOMKI. Separate abstracts have been prepared for the contributions to this annual report. (DWL)

16469 (INIS-SU—427, pp 16-20) **Toroid polarizability of hydrogen-like atoms.** Costescu, A.; Radescu, E.E. (Bucharest Univ., Romania; Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Theoretical Physics). 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780043/JAW. (JINR-N—20-86).

In JINR rapid communications. Collection.

A closed formula is obtained for the frequency-dependent toroid dipole polarizability $\gamma(\omega)$ of a (nonrelativistic, spinless, ground-state) hydrogen-like atom. The static result reads $\gamma(\omega=0)=(23/60)\alpha a_0 Z^{-4}$ (α - fine structure constant, Z - nucleus charge number, a_0 - Bohr radius). This is the toroid analog of the well-known static electric dipole polarizability $\alpha(\omega=0)=(9/2)Z^{-4}a_0^3$. 9 refs.

16470 (INIS-SU—427, pp 27-32) **Production, identification and ion-at-surface X-ray spectroscopy of Kr/sup 35+/ and Kr/sup 36+/.** Donets, E.D.; Kartashov, S.V.; Ovsyannikov, V.P. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of High Energy). 1986. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780043/JAW. (JINR-N—20-86).

In JINR rapid communications. Collection.

Slow hydrogenlike krypton ions and bare krypton nuclei have been produced for the first time under physical laboratory conditions by the electron-beam ionization method. The ion charge states have been identified using characteristic X-ray emission arising from their recombination on a solid state surface. Preliminary data on the transition energy and transition probability in the K-band X-ray emission have been obtained for these cases. 8 refs.; 2 figs.

16471 (INIS-SU—431, pp 410) **/sup 14/N nuclei polarization.** Zaika, N.I.; Magal', M.I. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16472 (JINR-R—6-86-134) **Measurement of natural widths of the thulium atomic levels in the /sup 169/Yb decay.** Pokrovskij, V.N.; Inoyatov, A.Kh.; Prostakov, I.A.; Vylov, Ts.; Minkova, A.; Pas'ko, A.A.; Brianson, Sh.; Legran, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 10p. (In Russian). (CONF-8604320—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701387/JAW.

From 36. All-Union conference on nuclear spectroscopy and nuclear structure; Kharkov, Ukrainian SSR (15 Apr 1986).

Spectra of low-energy conversion electrons emitted in the decay of /sup 57/Co, /sup 169/Yb and /sup 201/Tl were measured on a combined electrostatic spectrometer. High energy part of the conversion lines measured was approximated by folding a Lorentz distribution (width Γ) with a Gaussian one (width R) describing an instrumental line shape. The value of R was determined from the evaluation of the K-14.4 keV conversion line of /sup 57/Fe Co decay where the value of Γ is well-known. R=4.9 eV and R=6.8 eV have been obtained at different operational conditions of the spectrometer. The values of natural widths of thulium atomic levels obtained from the measurements $\Gamma(K)=35.5(3)$ eV, $\Gamma(L_1)=4.4(3)$ eV, $\Gamma(L_2)=4.0(4)$ eV, $\Gamma(L_3)=4.0(5)$ eV, $\Gamma(M_1)=13.9(3)$ eV, $\Gamma(M_2)=9.2(8)$ eV, $\Gamma(M_3)=9.5(12)$ eV are in good agreement with both the results of x-ray transition measurements and the semi-empirical data. 15 refs.; 7 figs.; 1 tab.

16473 (LA—11132-MS) **Generalized equations for emittance and field energy of high-current beams in periodic focusing.** Hofmann, I. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004448/JAW.

We derive a set of ordinary differential equations relating the rms emittance of a beam with its nonlinear field energy. The equations are valid in constant or periodic focusing and 1-D, 2-D, or 3-D and thus provide a general framework to study emittance growth. They allow us to estimate the expected total emittance growth, if the change of nonlinear field energy can be predicted from general principles, like the homogenization of charge density in beams that are space-charge dominated. Structure resonances in periodic focusing can be identified as a resonance between the envelope modulation and the oscillating nonlinear field-energy term. The equations lead to estimates for the maximum longitudinal-transverse emittance transfer in situations where equipartitioning occurs.

A comparison with results from computer simulation will be the subject of another paper in preparation. 12 refs.

16474 **(LA—11152-T) Effects of electric fields on the photodetachment cross section of the H^- ion near threshold.** Stewart, J.E. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 172p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88004073/JAW.

The photodetachment cross section of the H^- ion near the one electron threshold in electric fields ranging from approximately 5×10^{-7} atomic units up to 2.4×10^{-4} atomic units has been studied using an 800 MeV beam at the Los Alamos National Laboratory. The lowest field data, analyzed as though at zero field, are consistent with the Wigner prediction for p wave processes. At greater field values, photodetachment using σ polarized laser light displays the expected lowering of apparent threshold and evidence of tunneling. Using π polarized laser light the same features are seen with the addition of oscillations superimposed on the cross section. Three complementary explanations are presented for the oscillations. 42 refs., 35 figs., 8 tabs.

16475 **(LA-UR—87-4227) Rovibrational spectroscopy of ArCO van der Waals complex.** Campbell, E.J.; De Piante Johnston, A.; Buelow, S.J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-871246—1). NTIS, PC A02. Order Number DE88004291/JAW.

From International workshop on the structure of small molecules and ions; Neve Ilan, Israel (13 Dec 1987).

The information that can be obtained from the high resolution rovibrational spectra of small molecular clusters is very useful for determining intermolecular potentials and the effects of intermolecular interactions on intramolecular bonds. Recently, such spectra have been obtained via absorption measurements using F-center, frequency difference and diode laser sources. Because F-center and frequency difference lasers operate best in the 2-4 μm region, studies using these laser sources have involved high frequency vibrational modes (H-X, X-C,F,Cl,Br) or overtones. Although diode lasers cover a much broader spectral range (3-20 μm), they are less convenient to use for doing survey spectroscopy. We have developed several new techniques which improve the sensitivity and convenience of absorption measurements using diode lasers for the study of molecular clusters in supersonic expansions. Here we describe these techniques and their application for the measurement of the rovibrational spectra of ArCO near 5 μm. 11 refs., 4 figs., 1 tab.

16476 **(LA-UR—87-4244) Very high resolution saturation spectroscopy of lutetium isotopes via c-w single-frequency laser resonance ionization mass spectrometry.** Fearey, B.L.; Parent, D.C.; Keller, R.A.; Miller, C.M. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-871147—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004293/JAW.

From 3. international laser science conference; Atlantic City, NJ, USA (1 Nov 1987).

In this paper, we discuss the use of Resonance Ionization Mass Spectrometry (RIMS) to perform isotopically selective saturation spectroscopy of lutetium isotopes. Utilizing this technique, it is shown that accurate measurements of the relative frequencies of hyperfine (HF) components for different isotopes easily can be made without the need for an isotopically enriched sample. The precision with which the HF splitting constants can be determined is estimated to be ~5 times greater than in previous work.

16477 **(LBL—24169) Presentations to the SuperHILAC Program Advisory Committee.** McDonald, R.J. (ed.). (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 279p. (CONF-8709210—Vugraphs). NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88003853/JAW.

From SuperHILAC program advisory committee meeting; Berkeley, CA, USA (10 Sep 1987).

This paper contains viewgraphs on the SuperHILAC. The topics of these viewgraphs are: light charged particle emission as a probe of heavy-ion reactions; correlated charged-changing interactions and x-ray emission in ion-atom collisions; progress report on Sasay II and new nuclear chemistry experiments at the SuperHILAC; precision x-ray spectroscopy of heavy ions; 180°-correlated equal energy photons from 5.9 MeV/N U + Th collisions; research statement of excited states of monatomic and molecular systems; search for entrance-channel effects in the production of superdeformed nuclei; present and future research with OASIS; relaxation mechanisms in damped heavy-ion reactions; excitation energy division and nucleon transfer; test of QED and relativistic effects for strongly-bound electrons; heavy-ion Coulomb excitation and transfer reactions as probes of nuclear structure; and preliminary design of the Dilepton spectrometer.

16478 **(RAL—86-099) RATION and SPECTRA CODES-RAL version. H-like and He-like ionic population and line broadening of the resonance spectrum.** Chenais-Popovics, C. (Rutherford Appleton Lab., Chilton (UK)). Dec 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750965/JAW.

The paper is a guide for the users of the code RATION and SPECTRA. These codes concern helium-like and hydrogen-like ions of atomic number below 20. RATION calculates the populations of excited levels in a collisional-radiative model, for given electronic densities and temperatures. SPECTRA calculates the line shapes of the corresponding lines - Stark broadening is described with microfields. The whole spectrum including Doppler, Stark and a simple reabsorption model is plotted.

16479 **(UCID—21292) Spectral line-broadening codes for hydrogen-, helium- and lithium-like ions in plasmas.** Lee, R.W. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005238/JAW.

Information is provided on a set of three computer codes that allow the casual user to generate, accurately and rapidly, the spectral line profiles from certain transitions of hydrogen-, helium-, and lithium-like ions in a plasma. The codes produce state-of-the-art profiles 'instantly' (when you sit at the Cray) and provide the type of answers which are required for diagnostics and for laser gain estimations.

16480 **(UCRL—21002) Energy transfer reactions of $N_2(A^3\Sigma/sub\ u/^+)$ to SO and other diatomic and polyatomic molecules.** Cao, De Zhao; Setser, D.W. (Kansas State Univ., Manhattan (USA). Dept. of Chemistry). Dec 1987. Contract W-7405-ENG-48. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005414/JAW.

The total quenching rate constant of $N_2(A^3\Sigma/sub\ u/^+)$ by SO and the formation rate constant of $SO(A^3\pi)$ have been measured using microwave discharges of dilute $SOCl_2$/Ar and SOF_2/Ar mixtures as sources of SO(X). The initial vibrational distribution of SO(A) was estimated by extrapolating the steady-state distributions to low Ar pressure. The vibrational and electronic product state distributions from other excitation-transfer reactions of $N_2(A)$ are summarized and compared with the SO and S_2 reactions. Total quenching rate constants of $N_2(A^3\Sigma/sub\ u/^+)$ also were measured for several diatomic halogens and for PF_3, PCl_3, $POCl_3$, NF_3, SOF_2, SO_2F_2, CCl_2F_2, CF_4 and HN_3. In several instances, effective $N_2(A)$ decay constants also were measured for dilute mixtures of these reagents that had been passed through a microwave discharge. Unsuccessful attempts to excite $PF(A^3\pi)$, $PCl(A^3\pi)$, $PO(B^2\Sigma^+)$ and $CF_2(A\text{-tilde}^1A_1)$ from reaction of $N_2(A)$ with the products from the microwave discharges of PF_3, PCl_3, $POCl_3$ and CF_2Cl_2 (and CF_4) are summarized. The rate constants for formation of $I_2(D')$ from I_2 and NH(A) from HN_3 are small. Qualitative experiments demonstrated that the $N_2(A) + XeF_2$ reaction does not have a significant branching fraction for XeF(B) formation. 55 refs., 8 figs. 5 tabs.

16481 **(UCRL—97897) Resonantly-enhanced, four-photon ionization of krypton at laser intensities exceeding 10^{12} W/cm^2.** Perry, M.D.; Landen, O.L.; Campbell, E.M. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 12p. (CONF-880110—15). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005038/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

The yield of singly- and multiply- charged ions of krypton and xenon is presented as a function of laser intensity and frequency. The measurements were performed using the second harmonic output of a well-characterized, tunable picosecond dye laser in the range 285 to 310 nm at laser intensities from 1 x 10^{12} to 10^{14} W/cm^2. Enhancement of the Kr^+ yield by two orders of magnitude by three-photon resonant, four-photon ionization is observed in the vicinity of the 4d'[5/2]$_3$ and the 4d[3/2]$_1$ intermediate states. A model incorporating line shifts and widths scaling linearly with intensity is in good agreement with the experimental results.

16482 **Infrared flash kinetic spectroscopy of HCO.** Dane, C.B.; Lander, D.R.; Curl, R.F.; Tittel, F.K.; Guo, Y.; Ochsner, M.I.F.; Moore, C.B. (Chemistry and Electrical Engineering Departments and Rice Quantum Institute, Rice University, Houston, Texas 77251). *Journal of Chemical Physics;* **88**: No. 4, 2121-2128(15 Feb 1988).

The high resolution infrared spectrum of the CH stretching fundamental of the formyl radical (HCO) has been observed by means of infrared kinetic spectroscopy using 308 nm (XeCl) excimer laser flash photolysis of formaldehyde or acetaldehyde followed by diode or difference frequency laser probing of the transient absorption. The high resolution spectra obtained were assigned and fitted with rotational, spin—rotational, and centrifugal distortion constants. The ν_1 band origin is 2434.48 cm^{-1}. New ground-state constants are reported from a least-squares fit combining this ν_1 data with previous microwave and FIR LMR measurements.

16483 **High-resolution photoionization spectrum of water molecules in a supersonic beam.** Page, R.H.; Larkin, R.J.; Shen, Y.R.; Lee, Y.T. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **88**: No. 4, 2249-2263(15 Feb 1988). Contract AC03-76SF00098.

We have obtained high-resolution (~1.5 cm^{-1}) photoionization spectra of supersonically cooled (T/sub rot/~50 K) H_2O and D_2O in the 1000—900 A range. The light source, which used the technique of frequency tripling in a pulsed free jet of gas, is described briefly. Spectra are rotationally resolved. Vibrationally excited autoionizing Rydberg series converging to the ground electronic [X; $(1b_1)^{-1}$] state of the molecular ion are detected. This may well be the first example of a highly resolved Rydberg spectrum of a stable polyatomic molecule. From the convergence limit, the ionization potential H_2O is determined to be 101 777 +- 7 cm^{-1}. Intensities of the Rydberg state autoionization signals are smaller than predicted with known Franck—Condon factors, indicating that predissociation is a competitive decay channel. Rydberg state lifetimes are ~1 ps, deduced from homogeneous linewidths. Autoionizing features from Rydberg states associated with the ion's quasilinear A-italic-tilde $(3a_1)^{-1}$ state are observed with linewidths above 10 cm^{-1}, indicating that their lifetimes are less than ~0.5 ps. Rotational assignments of some of the bands in this linear←bent transition show that the Rydberg and ionic state geometries are nearly identical. A consistent assignment of the controversial bending (ν_2) quantum number and Rydberg series quantum defect δ = -0.037 have been provided.

16484 **Photoionization of aligned molecular excited states.** Appling, J.R.; White, M.G.; Kessler, W.J.; Fernandez, R.; Poliakoff, E.D. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **88**: No. 4, 2300-2308(15 Feb 1988). Contract AC02-76CH00016.

Photoelectron angular distributions of several excited states of NO have been measured in an effort to better elucidate the role of alignment in resonant multiphoton excitation processes of molecules. In contrast to previous molecular REMPI measurements on NO, (2+1) angular distributions taken for low rotational levels of the E $^2\Sigma^+$ ($4s\sigma$) Rydberg state of NO exhibit complex angular behavior which is characteristic of strong spatial alignment of the optically prepared levels. Photoelectron angular distributions were also found to be strongly branch and J dependent with the lowest rotational levels of the $R_{21}+S_{11}$ branch exhibiting the full anisotropy expected for an overall three-photon process. Fluorescence anisotropies extracted from complementary two-photon fluorescence angular distribution measurements reveal small, but nonzero alignment in all rotational levels with $J>1/2$, in contrast to the photoelectron results. Additional photoelectron angular distributions taken for (1+1) REMPI via the A $^2\Sigma^+$ ($3s\sigma$), v = 0 state exhibit near "$\cos^2\theta$" distributions characteristic of photoionization of unaligned target states. The observed photoelectron data are qualitatively interpreted on the basis of the angular momentum constraints of the excitation-induced alignment and photoionization dynamics which determine the observable moments in the angular distribution.

16485 **Strong monopole electron-collisional excitation in highly stripped ions.** Hagelstein, P.L.; Dalhed, S. (Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] A: General Physics;* **37**: No. 4, 1357-1360(15 Feb 1988).

The collision strengths for electric monopole collisional excitation of the outermost subshell of highly stripped closed-shell ions are examined and found to scale nearly hydrogenically. The collision strength near threshold for the principal monopole excitation process (in the distorted-wave approximation) is written as $\Omega(Z) = \xi$/sub n//sub l/(Z)eta/sub nl/(Z)N/sub nl/l/sub H//$\Delta E(Z)$, where ξ/sub n//sub l/(Z) is near 0.3, 0.5, and 0.6 for the He-like (1s—2s), Ne-like (2p—3p), and Ni-like (3d—4d) sequences, respectively, and where eta/sub n//sub l/(Z) accounts for mixing effects and is near unity at low Z. The excitation process in nickel-like ions is more effective per electron than for neonlike ions and is favorable to the development of x-ray lasers below 44 A. The extension of the monopole excitation scheme to Nd-like ions appears very attractive for longer wavelengths.

16486 **Intermediate-velocity atomic collisions: Electron capture and loss in 10—42-MeV C ions.** Anholt, R.; Xu, X.; Stoller, C.; Molitoris, J.D.; Meyerhof, W.E.; Rude, B.S.; McDonald, R.J. (Department of Physics, Stanford University, Stanford, California 94305). *Physical Review [Section] A: General Physics;* **37**: No. 4, 1105-1114(15 Feb 1988).

The capture and loss of electrons for incident bare, one-, two-, and three-electron 10—42-MeV carbon ions are studied. The one-electron-loss cross sections are compared with Glauber-approximation 1s ionization calculations, and a way of incorporating target-atom screening into the Glauber theory is proposed. The electron-capture cross sections agree reasonably well with eikonal-approximation results. The equilibrium charge states of the highest-energy C ions emerging from solid targets can be calculated accurately from gas-target equilibrium charge states using a theory incorporating excited-state effects.

16487 **(1+1) resonant enhanced multiphoton ionization via the A $^2\Sigma^+$ state of NO: Ionic rotational branching ratios and their intensity dependence.** Rudolph, H.; Dixit, S.N.; McKoy, V.; Huo, W.M. (Athur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). *Journal of Chemical Physics;* **88**: No. 3, 1516-1521(1 Feb 1988).

Recent high resolution photoelectron spectroscopic studies of the (1+1) resonant enhanced multiphoton ionization (REMPI) of NO via the 0—0 transition of the A—X band (γ band) have shown a pronounced $\Delta N = 0$ signal (ΔNequivalentN/sub +/-N/sub i/) and smaller, but measurable, $\Delta N = +- 2$ peaks. The authors [K. S. Viswanathan et al., J. Phys. Chem. 90, 5078 (1986)] assign the excitation to be via an R(21.5) line, with no further specification. We have performed ab initio calculations of the rotational branching ratios for the four possible "R(21.5)" transitions, namely, the rotationally "clean" R_{21} and R_{22}, and the "mixed" $R_{12}+Q_{22}$ and $R_{11}+Q_{21}$ branches. We find the mixed $R_{12}+Q_{22}$(21.5) branch to agree best with the observed photoelectron spectrum collected parallel to the polarization vector of the light. The discrepancy is larger for detection perpendicular to the polarization. To understand this difference, we have assessed the influence of laser intensity and polarization "contamination" on the branching ratios and photoelectron angular distributions.

16488 Phosphorescence excitation spectroscopy in supersonic jets. The lowest triplet state of pyrazine. Tomer, J.L.; Holtzclaw, K.W.; Pratt, D.W.; Spangler, L.H. (Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *Journal of Chemical Physics;* **88**: No. 3, 1528-1538(1 Feb 1988).

Motivated principally by dynamic issues, we have observed and assigned the laser-induced phosphorescence excitation spectrum of pyrazine in the collision-free environment of a supersonic jet. The origin of the lowest triplet state (T_1) lies at 26 820 cm^{-1} and exhibits a symmetric parallel-type rotational contour, confirming that this state is $^3B_3$/sub u/ ($n\pi^*$) with an equilibrium geometry that is similar to those of the S_0 (^1A/sub g/) and S_1 ($^1B_3$/sub u/, $n\pi^*$) states. Thirty vibrational bands were also observed in the ~4000 cm^{-1} interval between the T_1 and S_1 origins. Of these, the 13 lower energy bands all exhibit parallel-type contours and may be assigned as $T_1 \leftarrow S_0$ transitions, principally involving totally symmetric modes. The 17 higher energy bands exhibit both parallel and perpendicular contours and may be assigned as $S_1 \leftarrow S_0$ hot band transitions, some involving nontotally symmetric modes. No evidence for a second, $\pi\pi^*$ triplet state lying below the S_1 origin is found, nor is there any evidence for rapid relaxation of any of the zero-order T_1 levels at a resolution of ~1 cm^{-1}.

16489 193 nm laser photofragmentation time-of-flight mass spectrometric study of CS_2 and CS_2 clusters. Tzeng, W.; Yin, H.; Leung, W.; Luo, J.; Nourbakhsh, S.; Flesch, G.D.; Ng, C.Y. (Ames Laboratory, U. S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics;* **88**: No. 3, 1658-1669(1 Feb 1988). Contract W-7405-ENG-82.

A crossed laser and molecular beam photofragmentation apparatus is described. The apparatus is equipped with a rotatable molecular beam source and a translationally movable ultrahigh vacuum mass spectrometer for time-of-flight (TOF) measurements. Using this apparatus we have measured the TOF spectra of S and CS resulting from the photofragmentation processes, $CS_2 + h\nu$(193 nm)$\rightarrow$CS(X,v)+S(^{1}D or ^{3}P). The translational energy distributions of photofragments derived from the S and CS TOF spectra are in good agreement. This observation, together with the finding that the TOF spectra of S and CS are independent of laser power in the 25—150 mJ range, shows that the further absorption of a laser photon by CS to form C(^{3}P)+S(^{3}P) within the laser pulse is insignificant. The TOF spectra of S obtained at electron ionization energies of 20 and 50 eV are indiscernible, indicating that the contribution to the TOF spectrum of S from dissociative ionization of CS is negligible at electron impact energies $\leqq$50 eV. The thermochemical thresholds for the S(^{1}D) and S(^{3}P) channels are determined to be 18.7 and 45.0 +- 0.4 kcal/mol, respectively, consistent with literature values. Structures found in the translational energy distribution can be correlated with vibrational structures of CS(X,v = 0—5) associated with the S(^{1}D) channel. The translational energy distribution supports the previous observation that the vibrational state distribution of CS(X,v) is peaked at v = 3.

16490 Photodissociation of semiconductor positive cluster ions. Zhang, Q.; Liu, Y.; Curl, R.F.; Tittel, F.K.; Smalley, R.E. (Rice Quantum Institute, Departments of Chemistry and Electrical Engineering, Rice University, Houston, Texas 77251). *Journal of Chemical Physics;* **88**: No. 3, 1670-1677(1 Feb 1988).

Laser photofragmentation of Si, Ge, and GaAs positive cluster ions prepared by laser vaporization and supersonic beam expansion has been investigated using tandem time-of-flight mass spectrometry. Si clusters up to size 80, Ge clusters to size 40, and GaAs clusters up to a total of 31 atoms were studied. Si^+/sub n/ and Ge^+/sub n/ for n = 12—26 give daughter ions of about half their original size. For both Si and Ge, this apparent positive ion fissioning appears to go over with increasing n to neutral loss of seven and ten, but for Si^+/sub n/ the range of n values where this is observed is rather small. At low fluences, the larger Ge^+/sub n/ clusters up to the maximum size observed (50) sequentially lose Ge_{10} (and in some cases with lower intensity Ge_7). Larger Si^+/sub n/ clusters (n>30) always fragment primarily to produce positive ion clusters in the 6—11 size range with a subsidiary channel of loss of a single Si atom. At high laser fluences, Ge^+/sub n/ also fragments to produce primarily positive ion clusters in the 6—11 size range with an intensity pattern essentially identical to Si^+/sub n/ at similar fluences. Ga/sub x/As^+/sub y/ clusters lose one or more atoms in what is probably a sequential process with positive ion clusters in which the total number of atoms, x+y, is odd being more prominent.

16491 Photoionization of the valence orbitals of OH. Stephens, J.A.; McKoy, V. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). *Journal of Chemical Physics;* **88**: No. 3, 1737-1742(1 Feb 1988).

We report the results of studies of the photoionization cross sections and asymmetry parameters for the 3σ and 1π levels of OH, corresponding to the production of the A ^{3}Pi, c ^{1}Pi, a $^1\Delta$, b $^1\Sigma^+$, and X $^3\Sigma^-$ molecular ions. The calculations employed multiplet-specific Hartree—Fock potentials and numerical photoelectron continuum orbitals, obtained using the iterative Schwinger variational method. Noticeable nonstatistical behavior of the cross sections is seen, mainly for the 1π level, although deviations are not as pronounced as in other open-shell systems. Comparison with fragmentary experimental data is encouraging, although synchrotron radiation studies are needed to fully assess the accuracy of the calculated cross sections.

16492 Statistical theory of electron densities. Pratt, L.R.; Hoffman, G.G.; Harris, R.A. (Chemical and Laser Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **88**: No. 3, 1818-1823(1 Feb 1988).

An optimized Thomas—Fermi theory is proposed which retains the simplicity of the original theory and is a suitable reference theory for Monte Carlo density functional treatments of condensed materials. The key ingredient of the optimized theory is a neighborhood sampled potential which contains effects of the inhomogeneities in the one-electron potential. In contrast to the traditional Thomas—Fermi approach, the optimized theory predicts a finite electron density in the vicinity of a nucleus. Consideration of the example of an ideal electron gas subject to a central Coulomb field indicates that implementation of the approach is straightforward. The optimized theory is found to fail completely when a classically forbidden region is approached. However, these circumstances are not of primary interest for calculations of interatomic forces. It is shown how the energy functional of the density may be constructed by integration of a generalized Hellmann—Feynman relation. This generalized Hellmann—Feynman relation proves to be equivalent to the variational principle of density functional quantum mechanics, and, therefore, the present density theory can be viewed as a variational consequence of the constructed energy functional.

16493 Multiphoton ionization of the noble gases by an intense 10/sup 14/-W/cm^2 dye laser. Perry, M.D.; Landen, O.L.; Szoeke, A.; Campbell, E.M. (Department of Nuclear Engineering, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *A: General Physics;* **37**: No. 3, 747-760(1 Feb 1988).

The absolute yield of multiply charged ions of the noble gases argon, krypton, and xenon as a function of laser intensity in the range of 10/sup 13/$\leqq$I$\leqq$5 x 10/sup 14/ W/cm^2 is reported. The actual numbers of ions produced using a well-characterized tunable picosecond dye laser were measured. These absolute measurements allow a direct, quantitative comparison of the data with theory. Both lowest-order perturbation theory and the "tunneling ionization" theory of Keldysh are used to model the experiment. Ionization rates obtained from the Keldysh theory are in quantitative agreement with the experimental results for production of the first charge state only. Reasons for the inability of the Keldysh theory to describe the production of multiply charged ions are discussed.

16494 Study of collisional disalignment of state-selected nitric oxide A $^2u^+$ (J,M/sub J/) using multiphoton ionization. Snow, L.D.; Compton, R.N.; Miller, J.C. (Department of Chemistry, The University of Tennessee, Knoxville, Tennessee 37996). *Journal of Chemical Physics;* **88**: No. 3, 1652-1657(1 Feb 1988).

An optical—optical double resonance technique using a multiphoton ionization detection scheme is employed to study the disalignment (collisional redistribution of M/sub J/ levels) of state selected NO A $^2\Sigma^+$ ($v' = 0$, $J' = 4$ 1/2) upon collisions with Xe, N_2, NO, CO_2, and CHF_3. Cross sections for M/sub J/ -changing collisions are estimated from two-color polarization measurements as a function of the pressure of the perturbing gas.

16495 Disappearance of continuum exchange integrals from algebraic variational calculations of electron scattering. Rescigno, T.N.; Schneider, B.I. (Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **37**: No. 3, 1044-1046(1 Feb 1988).

We show how it is possible to systematically eliminate, with little resulting error, all "free-free" and "bound-free" exchange integrals needed to implement electron scattering calculations with algebraic variational techniques, such as the Kohn method. This elimination is rigorous within the framework of the separable approximation for exchange interactions and follows from certain invariance properties of the scattering wave function. The procedure is illustrated for the case of e^- +He and e^- +H scattering in the static-exchange approximation.

16496 Magnetic-field dependence of resonance recombination in spin-polarized atomic hydrogen. Silvera, I.F.; Godfried, H.P.; Eliel, E.R.; Brisson, J.G.; Gillaspy, J.D.; Mester, J.C.; Mallardeau, C. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). *Physical Review [Section] B: Condensed Matter;* **37**: No. 4, 1520-1524(1 Feb 1988).

The two-body recombination rate of spin-polarized atomic hydrogen has been studied at fixed temperatures in low magnetic fields. Rates in excess of the surface rate are attributed to resonant recombination. The field dependence of the lifetime of the bound state has been approximated by the relation $\tau = \tau_0 \exp(-\alpha B)$, and values for τ_0 and α have been determined.

16497 Fine and magnetic hyperfine structure in the A ^{2}Pi and X ^{2}summation$^+$ states of yttrium monoxide. Childs, W.J.; Poulsen, O.; Steimle, T.C. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **88**: No. 2, 598-606(15 Jan 1988). Contract W-31-109-ENG-38.

A molecular beam optical and rf—optical double resonance spectroscopic study of numerous vibrational components in the A^{2}Pi$_{3}$/sub //$_2$—X^{2}summation$^+$ subband of gas phase YO has been performed. The fine and magnetic hyperfine parameters for v = 0—4 of the X^{2}summation$^+$ state have been determined. The observed strong vibrational dependence of the spin—rotation parameter γ(X^{2}summation$^+$) is proposed to arise from a perturbation from two as yet unobserved low-lying ^{2}Pi states coming from a three open-shell configuration. The magnetic hyperfine parameters for the X^{2}summation$^+$ state can be interpreted in terms of a single unpaired electron model. An estimate for the A^{2}Pi excited state dipolar parameter has been established.

16498 Spectroscopy of the 3p ^{2}Pi Rydberg state of HCO by resonance-enhanced multiphoton ionization. Tjossem, P.J.H.; Cool, T.A.; Webb, D.A.; Grant, E.R. (School of Applied and Engineering Physics, Cornell University, Ithaca, New York 14853). *Journal of Chemical Physics;* **88**: No. 2, 617-626(15 Jan 1988).

High resolution two-photon resonant, three-photon ionization spectra of HCO and DCO are presented for wavelengths from 373 to 460 nm. Rotational analysis of the (K',K") = (0,2) and (0,1) subbands and measurements of spin—rotation splitting on the (0,2) subband provide a definitive assignment of the (070)←(000) band of the bent-to-linear 3p ^{2}Pi(A")←X ^{2}Pi(A') Rydberg absorption in HCO. Bands from nine vibrational states in HCO and ten in DCO, attributable to a (0n0)←(000) bending mode progression in the 3p Rydberg state, are observed and assigned. Additional bands in HCO and DCO are assignable to (0n1)←(000) 3p progressions. Values for the 3p ^{2}Pi fundamentals $\nu_2 = 822.1(0.7)$ cm^{-1}, $\nu_3 = 2177(3)$ cm^{-1} for HCO and $\nu_2 = 657(2)$= cm^{-1}, $\nu_3 = 1900(5)$ cm^{-1} for DCO were measured. Additional unassigned partial progressions are provisionally attributed to 3s ^{2}summation$^+$←X ^{2}Pi(A') transitions.

16499 Ionic rotational branching ratios in resonant enhanced multiphoton ionization of NO via the A $^2u^+$ (3sσ) and D $^2\Sigma^+$ (3pσ) states. Rudolph, H.; Dixit, S.N.; McKoy, V.; Huo, W.M. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). *Journal of Chemical Physics;* **88**: No. 2, 637-641(15 Jan 1988).

We present the results of ab initio calculations of the ionic rotational branching ratios in NO for a (1+1) REMPI (resonant enhanced multiphoton ionization) via the A $^2\Sigma^+$(3sσ) state and a (2+1) REMPI via the D $^2\Sigma^+$(3pσ) state. Despite the atomic-like character of the bound 3sσ and 3pσ orbitals in these resonant states, the photoelectron continuum exhibits strong l mixing. The selection rule $\Delta N+l$ = odd (ΔNequivalentN/sub +/-N/sub i/) implies that the peaks in the photoelectron spectrum corresponding to ΔN = odd (+- 1, +- 3) are sensitive to even partial waves while those corresponding to even ΔN probe the odd partial waves in the photoelectron continuum. Recent experimental high resolution photoelectron studies have shown a strong $\Delta N = 0$ peak for ionization via the A $^2\Sigma^+$ and the D $^2\Sigma^+$ states, indicating a dominance of odd-l partial waves. While this seems natural for ionization out of the 3sσ orbital, it is quite anomalous for 3pσ ionization. Based on extensive bound calculations, Viswanathan et al. [J. Phys. Chem. 90, 5078 (1986)] attribute this anomaly to a strong l mixing in the electronic continuum caused by the nonspherical molecular potential.

16500 Diagrammatic theory of temperature-dependent resonance Raman scattering from polyatomic systems with general harmonic potential surfaces. Tonks, D.L.; Page, J.B. (Los Alamos National Laboratory, Group T-1, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **88**: No. 2, 738-760(15 Jan 1988).

A detailed derivation and discussion is given of our diagrammatic theory of temperature-dependent resonance Raman (RR) scattering and the optical absorption for multimode systems having general quadratic plus linear electron-vibrational coupling. By combining the time-correlator reformulation of RR scattering with suitably developed nonzero temperature many-body diagrammatic techniques, we obtain the RR excitation profiles and the absorption as one-dimensional Fourier transforms of analytic expressions involving just the model parameters and the temperature. The expressions are very convenient for explicit multimode model calculations. In addition, the theory brings out in a natural way the relation between RR profiles and the absorption, such that within well-defined special cases useful "transform" techniques can

16501 Spin—orbit and electronic autoionization in HCl. Lefebvre-Brion, H.; Dehmer, P.M.; Chupka, W.A. (Laboratoire de Photophysique Moleculaire, Bat. 213, Universite de Paris-Sud, 91405 Orsay, France). *Journal of Chemical Physics;* **88**: No. 2, 811-817(15 Jan 1988).

The high resolution relative photoionization cross section for HCl is reported in the wavelength region 720—975 A. In addition, results of calculations are presented for spin—orbit autoionization in the energy region between the X ^{2}Pi/sub 3/2/ and X ^{2}Pi/sub 1/2/ ionization thresholds and for electrostatic autoionization in the energy region containing Rydberg series converging to the A $^2\Sigma^+$ excited ionic state. For the case of spin—orbit autoionization in the region just above the X ^{2}Pi/sub 3/2/ ionic threshold, it is found that the energy positions of the first peaks are approximately correct if the ionization potential is modified by ≈80 cm^{-1}; however the intensities of the peaks are strongly perturbed, most probably by high lying vibrational levels of the V $^1\Sigma^+$ valence state. In the wavelength region 780—930 A, two progressions of Rydberg states converging to the A $^2\Sigma^+$ excited ionic state and autoionized by electrostatic interaction are also studied by ab initio multichannel

quantum defect theory. Qualitative agreement with the experimental data is obtained by a slight adjustment of some quantum defects, the other parameters being those obtained by ab initio calculations. Comparison with the absorption spectra of both HCl and DCl is also made. Progression I of Terwilliger and Smith [J. Chem. Phys.

16502 **Atomic and molecular alignment from photoelectron angular distributions in (n+1) resonantly enhanced multiphoton ionization.** Dubs, R.L.; McKoy, V.; Dixit, S.N. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). *Journal of Chemical Physics;* 88: No. 2, 968-974(15 Jan 1988).

Two distinct (n+1) REMPI techniques for obtaining the alignment of gas phase atoms and molecules from photoelectron angular distributions are presented. In both methods, the alignment is extracted from the angular distributions independently of the photoionization dynamics. The first method, which takes advantage of circular dichroism in the angular distributions (CDAD) has already been established experimentally as a useful probe of state alignment. The theory outlined in previous work is expanded here. The second method involves photoionization with light linearly polarized along the photoelectron collection direction and is presented here for the first time.

16503 **Multiphoton ionization of cesium via quadrupole transitions: Photoelectron angular distributions and polarization effects on total ionization rates.** Lyras, A.; Dai, B.; Tang, X.; Lambropoulos, P.; Dodhy, A.; Stockdale, J.A.D.; Zei, D.; Compton, a.R.N. (Department of Physics, University of Southern California, Los Angeles, California 90089-0484). *Physical Review [Section] A: General Physics;* 37: No. 2, 403-411(15 Jan 1988).

We report measurements of photoelectron angular distributions via electric quadrupole transitions in cesium atoms using multiphoton excitation techniques. Experimental results are presented for the cases of one-photon resonant, two-photon ionization via the 6d ^{2}D/sub 3/2/ and 6d ^{2}D/sub 5/2/ electric quadrupole transitions and for one-photon resonant, three-photon ionization via the 5d ^{2}D/sub 3/2/ and 5d ^{2}D/sub 5/2/ transitions. The ratios of the total ionization rates for linearly and circularly polarized light have also been measured for the 6d ^{2}D/sub 3/2/ and 6d ^{2}D/sub 5/2/ states. A theoretical analysis and detailed comparison with the experimental results are given.

16504 **Vibrationally resolved photoelectron angular distributions for H_2 in the range 17 eV≦hν≦39 eV.** Parr, A.C.; Hardis, J.E.; Southworth, S.H.; Feigerle, C.S.; Ferrett, T.A.; Holland, D.M.P.; Quinn, F.M.; Dobson, B.R.; West, J.B.; Marr, G.V.; and others. (National Bureau of Standards, Gaithersburg, Maryland 20899). *Physical Review [Section] A: General Physics;* 37: No. 2, 437-443(15 Jan 1988).

Vibrationally resolved photoelectron angular distributions have been measured for photoionization of H_2 over the range 17 eV≦hν≦39 eV using independent instrumentation at two synchrotron radiation facilities. The present data greatly extend and add vibrational resolution to earlier variable-wavelength measurements. The average magnitude of the asymmetry parameter continues to lie lower than the best independent-electron calculations. Broad structure is observed for the first time, possibly indicating the effects of channel interaction with dissociative, doubly excited states of H_2. Neither the average magnitude nor the gross wavelength-dependent structure vary strongly with the final vibrational channel.

16505 **Some recoil corrections to the hydrogen hyperfine splitting.** Bodwin, G.T.; Yennie, D.R. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] D: Particles and Fields;* 37: No. 2, 498-523(15 Jan 1988). Contract W-31-109-ENG-38.

We compute all of the recoil corrections to the ground-state hyperfine splitting in hydrogen, with the exception of the proton polarizability, that are required to achieve an accuracy of 1 ppm. Our approach includes a unified treatment of the corrections that would arise from a pointlike Dirac proton and the corrections that are due to the proton's non-QED structure. Our principal new results are a calculation of the relative order-α^2(m/sub e//m/sub p/) contributions that arise from the proton's anomalous magnetic moment and a systematic treatment of the relative order-α(m/sub e//m/sub p/) contributions that arise from form-factor corrections. In the former calculation we introduce some new technical improvements and are able to evaluate all of the expressions analytically. In the latter calculation, which has been the subject of previous investigations by other authors, we express the form-factor corrections in terms of two-dimensional integrals that are convenient for numerical evaluation and present numerical results for the commonly used dipole parametrization of the form factors. Because we use a parametrization of the form factors that differs slightly from the ones used in previous work, our numerical results are shifted from older ones by a small amount.

16506 **Rotational transitions in compound muonic molecules.** Padial, N.T.; Cohen, J.S.; Walker, R.B. (Physics Department, Rice University, Houston, Texas 77251). *Physical Review [Section] A: General Physics;* 37: No. 2, 329-339(15 Jan 1988).

Cross sections and rate constants are calculated for collision-induced rotational transitions of compound muonic molecules, which determine relaxation rates important to muon-catalyzed fusion processes. The interaction potential is derived from the H_2-H_2 potential, and the R-matrix propagation method is used to solve the set of coupled collisional equations for the systems D_2+[(dtμ)dee], D_2+[(ddμ)dee], T_2+[(dtμ)dee], D_2+[(dtμ)tee], and H_2+[(ddμ)pee]. Calculations are also done on H_2+HD and D_2+HD for comparison with previous work.

16507 **Nuclear effects on the eigenvalues of the dtμ molecule.** Struensee, M.C.; Hale, G.M.; Pack, R.T.; Cohen, J.S. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* 37: No. 2, 340-348(15 Jan 1988).

The latest information about the ^{5}He nuclear system in terms of R-matrix parameters has been matched to adiabatic dtμ molecular wave functions in order to determine the complex eigenvalues of the molecule. Through the use of the reduced R-matrix formalism, the matching is accomplished by considering only the L = 0 dtμ states explicitly. These states are calculated in a series of increasingly more accurate adiabatic approximations that, at least for the lowest vibrational level, appear to be converging to the exact nonadiabatic result. The best complex eigenvalues thus obtained probably have less than 10% uncertainty, and are in reasonably good agreement with those of Bogdanova et al. (Zh. Eksp. Teor. Fiz. 81, 829 (1981) [Sov. Phys.: JETP 54, 442 (1981)]).

16508 **Chemical bond as a test of density-gradient expansions for kinetic and exchange energies.** Perdew, J.P.; Levy, M.; Painter, G.S.; Wei, S.; Lagowski, J.B. (Department of Physics and Quantum Theory Group, Tulane University, New Orleans, Louisiana 70118). *Physical Review [Section] B: Condensed Matter;* 37: No. 2, 838-843(15 Jan 1988).

Errors in kinetic and exchange contributions to the molecular bonding energy are assessed for approximate density functionals by reference to near-exact Hartree-Fock values. From the molecular calculations of Allan et al. and of Lee and Ghosh, it is demonstrated that the density-gradient expansion does not accurately describe the noninteracting kinetic contribution to the bonding energy, even when this expansion is carried to fourth order and applied in its spin-density-functional form to accurate Hartree-Fock densities. In a related study, it is demonstrated that the overbinding of molecules such as N_2 and F_2, which occurs in the local-spin-density (LSD) approximation for the exchange-correlation energy, is not attributable to errors in the self-consistent LSD densities. Contrary to expectations based upon the Gunnarsson-Jones nodality argument, it is found that the LSD approximation for the exchange energy can seriously overbind a molecule even when bonding does not create additional nodes in the occupied valence orbitals. LSD and exact values for the exchange contribution to the bonding energy are displayed and discussed for several molecules.

16509 **New method for ion charge-state analysis.** Brown, I.G.; Kelly, J.C. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Applied Physics;* 63: No. 1, 254-256(1 Jan 1988). Contract AC03-76SF00098.

We present results showing charge-state separation of an ion beam in a purely cylindrical geometry, using the azimuthal magnetic field of a straight conductor. This geometry, which we refer to as a current coaxial lens, has advantages for the analysis of intense ion beams where it is important to minimize space-charge blowup of the beam due to loss of space-charge neutralization.

16510 **Effect of temperature on the uniform field breakdown strength of electronegative gases.** Christophorou, L.G.; Mathis, R.A.; Hunter, S.R.; Carter, J.G. (Atomic, Molecular, and High Voltage Physics Group, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6122). *Journal of Applied Physics;* 63: No. 1, 52-59(1 Jan 1988). Contract AC05-84OR21400.

In general, the electron attachment rate constant k/sub a/ (<ϵ>, T), as a function of the mean electron energy <ϵ> and temperature T for electronegative gases which attach electrons nondissociative ily, decreases greatly with T from room temperature to Tapprox. <600 K, while the k/sub a/ (<ϵ>, T) of electronegative gases which attach electrons dissociatively increases with increasing T.

16511 **Multichannel quantum defect treatment of the Rydberg states of CH_3I.** Dagata, J.A.; Scott, M.A.; McGlynn, S.P. (Department of Chemistry, Louisiana State University, Baton Rouge, Louisiana 70803). *Journal of Chemical Physics;* 88: No. 1, 9-14(1 Jan 1988).

An analysis of the observed electronic structure of the high-resolution absorption spectrum of CH_3I is presented for the energy regions above and below the first ionization limit. We show that the electronic effects of spin—orbit coupling and l mixing for Rydberg states built on a doublet ion core account for nearly all major features of the spectrum. The present results substantiate a recent ab initio calculation of the electronic multichannel quantum defect theory (MQDT) parameters for HI [H. Lefebvre-Brion, A. Guisti-Suzor, and G. Raseev, J. Chem. Phys. 83, 1557 (1985)]; they also illustrate an important feature of MQDT, namely, the ability to extrapolate channel mixing across threshold from the autoionization region into the discrete region.

16512 **Infrared spectroscopy of the cluster ions H^+a x(H_3)/sub n/.** Okumura, M.; Yeh, L.I.; Lee, Y.T. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* 88: No. 1, 79-91(1 Jan 1988). Contract AC03-76SF00098.

The vibrational spectra of the clusters $H^+_3(H_3)$/sub n/ were observed near 4000 cm^{-1} by vibrational predissociation spectroscopy. Spectra of mass-selected clusters were obtained by trapping the ions in a radio frequency ion trap, exciting vibrational transitions of the cluster ions to predissociating levels, and detecting the fragment ions with a mass spectrometer. Low resolution bands of the solvent H_2 stretches were observed for the clusters of one to six H_2 coordinated to an H^+_3 ion. The red shift of these vibrations relative to the monomer H_2 frequency supported the model of H^+_9 as an H^+_3 with a complete inner solvation shell of three H_2, one bound to each corner of the ion. Two additional bands of H^+_5 were observed, one assigned as the H^+_3 symmetric stretch, and the other as a combination or overtone band. High-resolution scans (0.5 and 0.08 cm^{-1}) of H^+/sub n/, n = 5, 7, and 9 yielded no observable rotational structure, a result of either spectral congestion or rapid cluster dissociation. The band contour of the H^+_5 band changed upon cooling the internal degrees of freedom, but the peaks remained featureless. The observed frequencies of H^+_7 and H^+_9 agreed well with ab initio predictions, but those of H^+_5 did not. This deviation is discussed in terms of the large expected anharmonicity of the proton bound dimer H^+_5.

16513 **Electronic states and potential energy surfaces of RhH.** Balasubramanian, K.; Liao, D. (Department of Chemistry, Arizona State University, Tempe, Arizona 85287-1604). *Journal of Chemical Physics;* 88: No. 1, 317-321(1 Jan 1988).

Complete active space MCSCF (CASSCF) followed by first-order configuration interaction (FOCI) calculations are carried out on nine λ—ϵ states of RhH. In addition, relativistic configuration interaction (RCI) calculations which include spin—orbit interaction are carried out on 19 ω—ω states of RhH. The potential energy surfaces and spectroscopic properties (R/sub e/,T/sub e/,ω/sub e/,D/sub e/,μ) are computed for the electronic states of RhH.The calculated CASSCF/FOCI dipole moments of both the ground and excited states reveal considerable ionic character (Rh^+H^-) with the exception of the $^1\Delta$ state which is somewhat less ionic. The spin—orbit effects are found to be quite significant for the electronic states of RhH. The spin—orbit contaminations of the low-Ω states [1,1(II),1(III),1(IV),0^+] are found to be appreciable. The spin—orbit splittings of low-lying electronic states were found to be 1200—3200 cm^{-1}.

16514 **Rotational partition functions for linear molecules.** McDowell, R.S. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* 88: No. 1, 356-361(1 Jan 1988).

An accurate closed-form expression for the rotational partition function of linear polyatomic molecules in ^{1}summation electronic states is derived, including the effect of nuclear spin (significant at very low temperatures) and of quartic and sextic centrifugal distortion terms (significant at moderate and high temperatures). The proper first-order quantum correction to the classical rigid-rotator partition function is shown to yield Q/sub r/ $\approx\beta^{-1}\exp(\beta/3)$, where βequivalenthcB/kT and B is the rotational constant in cm^{-1}; for $\beta\geqq 0.2$ additional power-series terms in β are necessary. Comparison between the results of this treatment and exact summations are made for HCN and C_2H_2 at temperatures from 2 to 5000 K, including separate evaluation of the contributions of nuclear spin and centrifugal distortion.

16515 **Rotational tunneling of bound H_2 in a tungsten complex.** Eckert, J.; Kubas, G.J.; Dianoux, A.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* 88: No. 1, 466-468(1 Jan 1988).

The rotational tunnel splitting of the librational ground state of activated molecular hydrogen bound in a tungsten complex has been determined to be 0.95 (1) cm^{-1}. With the assumption of a two-fold cosine potential with one degree of freedom for the rotation, this result yields a barrier height of 760 cm^{-1} in good agreement with the analysis of the librational data. These quantum mechanical rotations are also found to persist up to temperatures above 150 K. The relationship of these measurements to the binding of molecular hydrogen to the metal center are discussed.

16516 **Hyperfine structure of the $(5d+6s)^3$ configuration of /sup 139/La I: New measurements and ab initio multiconfigurational Dirac-Fock calculations.** Childs, W.J.; Nielsen, U. (Argonne National Laboratory, Argonne, Illinois 60439-4843). *Physical Review [Section] A: General Physics;* 37: No. 1, 6-15(1 Jan 1988). Contract W-31-109-ENG-38.

The atomic-beam laser-rf double-resonance method has been used to measure precisely the dipole and quadrupole hyperfine structure (hfs) of 11 levels of the $5d^26s$ configuration and four levels of the $5d^3$ configuration of /sup 139/La I. The results, together with earlier results for lower-lying levels, are compared in detail with new multiconfiguration Dirac-Fock (MCDF) ab initio calculations. The agreement is good to fair overall, but is poor in some areas. The comparison yields new insights and suggests areas in which the theoretical approach must be improved. In particular, the theory underestimates the importance of contact hfs in the $5d^26s$ configuration by 25—40 %. In addition, there is at present no self-consistent way in the MCDF approach to take account of the large core polarization observed in the $5d^3$ ^{4}F term.

16517 Collinear laser and slow-ion-beam apparatus for high-precision laser-rf double-resonance spectroscopy. Sen, A.; Goodman, L.S.; Childs, W.J. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439-4843). *Review of Scientific Instruments;* 59: No. 1, 74-80(Jan 1988). Contract W-31-109-ENG-38.

A new apparatus has been constructed for high-precision hyperfine structure measurement of atomic ions by laser-radio-frequency double-resonance technique involving a slow ion beam and a laser in collinear geometry. The low ion energy (1—1.5 keV) leads to longer interaction time with the applied rf field. Consequently, extremely narrow linewidths of ~60 kHz have been observed for the first time in such systems. The apparatus has been used for the measurement of hyperfine structure of the $4f^7(^8S^o)5d^9$ D°/sub 2,3,4,5/ metastable levels in $^{151}Eu^+$ and $^{153}Eu^+$. The magnetic dipole and the electric quadrupole hyperfine constants, A and B, respectively, have been determined with higher precision (2—3 orders of magnitude).

16518 S-wave optical potential in pionic atoms. Garcia-Recio, C.; Oset, E.; Salcedo, L.L. (Departamento de Fisica Teorica, Facultad de Ciencias, Valladolid, Spain). *Physical Review [Section] C: Nuclear Physics;* 37: No. 1, 194-214(Jan 1988).

We present a new formal approach for the calculation of the s-wave optical potential for pionic atoms which makes extensive use of the Lindhard function, its analytical properties, and its useful low density limit. The conventional parameters b_0 and B_0 are calculated and compared to results from empirical fits to pionic atom data. We show that the virtual excitation of ph-Δh components by the pion is the main source of the real part of B_0. Higher order effects from the polarization of the pion lead to some enhancement of ImB_0, providing values which are compatible with the empirical data. The real part of the potential suffers from larger uncertainties due to the off-shell extrapolation of the πN scattering amplitude.

16519 Comparison of motionally narrowed coherent anti-Stokes spectroscopy line shapes of H_2 with hard- and soft-collision models. Farrow, R.L.; Palme, R.E. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94550). *Optics Letters;* 12: No. 12, 984-986(Dec 1987).

We have compared high-resolution coherent anti-Stokes Raman spectroscopy measurements of the Q(1) transition of H_2 with theoretical line shapes incorporating both Doppler broadening and motional narrowing. Least-squares fits varying the motional narrowing coefficient for both the hard- and soft-collision model yielded line shapes that agreed well with observed spectra at 295 K for pressures between 50 and 3050 Torr. However, the narrowing coefficient for the hard-collision models was pressure dependent, whereas the narrowing coefficient for the soft-collision model was independent of pressure and yielded an optical diffusion coefficient that agreed with previously measured values.

16520 $3p^6 3d^9$—$3p^5 3d^{10}$ transitions of cobaltlike ions from Sr/sup 11+/ to U/sup 65+/. Ekberg, J.O.; Feldman, U.; Seely, J.F.; Brown, C.M.; Reader, J.; Acquista, N. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D.C. 20375-5000). *Journal of the Optical Society of America B: Optical Physics;* 4: No. 12, 1913-1918(Dec 1987).

The $3p^6 3d^9$ ^2D—$3p^5 3d^{10}$ ^2P transitions of the CO-like ions Ru/sup 17+/—Sb/sup 24+/, Sm/sup 35+/, Eu/sup 36+/, Gd/sup 37+/, Yb/sup 43+/, and AU/sup 52+/ were excited with laser-produced plasmas and photographed with grazing-incidence spectrographs. The observed wavelengths of the ^{2}D/sub 5/2/—^{2}P/sub 3/2/ and ^{2}D/sub 3/2/—^{2}P/sub 1/2/ transitions were compared with relativistically calculated ab initio wavelengths and, by fitting the differences between the observed and calculated wave numbers to simple formulas, least-squares fitted wavelengths were obtained for all ions from Sr/sup 11+/ to U/sup 65+/. The wavelengths range from 8 to 93 A. The estimated uncertainty of the fitted wavelengths is +- 0.005 A, which makes them useful as reference values. Smoothed values of the energy levels were derived from the fitted values of the wavelengths and $3p^6 3d^9$ ^2D fine-structure intervals. Wavelengths for the $3p^6 3d^9$ ^{2}D/sub 3/2/—$3p^5 3d^{10}$ ^{2}P/sub 3/2/ transitions and the $3p^6 3d^9$ ^{2}D/sub 5/2/—^{2}D/sub 3/2/ magnetic-dipole transitions were derived from the smoothed energy-level values.

16521 Cd I isoelectronic sequence: wavelengths and energy levels for Xe VII through Eu XVI. Kaufman, V.; Sugar, J. (Atomic & Plasma Radiation Division, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of the Optical Society of America B: Optical Physics;* 4: No. 12, 1919-1923(Dec 1987).

Low-inductance triggered-spark spectra of Xe through Eu were observed with the National Bureau of Standards 10.7-m normal- and grazing-incidence vacuum spectrographs. Transition arrays of the Cd I isoelectronic sequence were identified as well as those of the Pd I and Ag I sequences previously reported. Energy levels and fitted radial integrals were derived. Perturbations that are due to configuration crossings arising from the contraction of the 4f shell were revealed in these analyses. The ground configuration in the Cd I sequence changes from $5s^2$ to 5s4f at Sm XV and to $4f^2$ at Eu XVI.

16522 In I isoelectronic sequence: wavelengths and energy levels for Xe VI through La IX. Kaufman, V.; Sugar, J. (Atomic and Plasma Radiation Division, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of the Optical Society of America B: Optical Physics;* 4: No. 12, 1924-1926(Dec 1987).

Spectra of Xe, Cs, Ba, and La produced with a high-voltage spark discharge were observed photographically with the National Bureau of Standards 10.7-m normal- and grazing-incidence spectrographs. Identified lines of the In I isoelectronic sequence were used to determine the energy levels of the 5s ^{2}5p, 5s5p^2, 5s^{2}5d, and 5s^{2}6s configurations. Their interactions with unobserved configurations that include a 4f electron are discussed. Fitted values of the radial energy integrals were determined from the known levels.

16523 Resonance transitions in the Mg I and Ar I isoelectronic sequences from Cu to Mo. Sugar, J.; Kaufman, V.; Rowan, W.L. (Atomic and Plasma Radiation Division, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of the Optical Society of America B: Optical Physics;* 4: No. 12, 1927-1930(Dec 1987).

New measurements for the transitions $3s^2$ $^1S_0$—$3s3p^1$ $^3P^o_1$ in the Mg I isoelectronic sequence and for $3s^2 3p^6$ $^1S_0$—$3s^2 3p^5 3d$ $^1P^o_1$ and $^3D^o_1$ in the Ar I sequence are given for most of the elements from Cu to Mo. These measurements are compared with uniformly scaled relativistic Hartree—Fock calculations, and the wavelength differences are fit to a continuous function from which new smoothed values are derived with an estimated uncertainty of +- 0.005 A.

16524 Identification of new Ti XXI and Ti XIX transitions emitted by laser-produced plasmas. Moreno, J.C.; Goldsmith, S.; Griem, H.R.; Cohen, L.; Richardson, M.C. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Journal of the Optical Society of America B: Optical Physics;* 4: No. 12, 1931-1934(Dec 1987).

New spectral emission lines of Ti XXI and Ti XIX have been observed and classified from a laser-produced plasma. The wavelength region for these lines is from 12 to 15 A.

16525 Resonant multiphoton ionization of krypton by intense uv laser radiation. Landen, O.L.; Perry, M.D.; Campbell, E.M. (Lawrence Livermore National Laboratory, P.O. Box 5508, Livermore, California 94550). *Physical Review Letters;* 59: No. 22, 2558-2561(30 Nov 1987). Contract W-7405-ENG-48.

Low-pressure Kr and Xe gas has been irradiated by a high-intensity (3 x 10/sup 12/—10/sup 14/ W cm-2), short-pulse (1.3 ps), tunable laser beam. Enhancement of the Kr^+ yield by 2 orders of magnitude by three-photon—resonant four-photon ionization is observed at intensities 1 to 2 orders of magnitude above previous results. The 4p→5d $[(1/2)_1$ and 4p→4d $[(3/2)_1$ three-photon Kr resonance profiles are measured as a function of peak laser intensity and

are well fitted by a simple model incorporating line shifts and widths scaling linearly with laser intensity.

16526 **Role of symmetry of the final target state in the angular momentum transfer by electron impact excitation of atoms.** Csanak, G.; Cartwright, D.C. (Los Alamos National Lab., NM, USA). *J. Phys., B (London);* 20: No. 18, L603-L610(28 Sep 1987).

First-order many-body theory predicts that the electron-impact-induced orbital angular momentum transfer to the target, <Lsub(perpendicular)>, associated with excitation of the n/sup 1/D states of helium in the energy range 45-60 eV, is negative for scattering angles less than or equal to 50/sup 0/, in agreement with recent measurements. This negative behaviour for the n/sup 1/D states is opposite to that associated with excitation of the nsup(1,3)P and n/sup 3/D states for the same range of scattering angles. The qualitatively different characteristic of <Lsub(perpendicular)> for excitation of n/sup 1/D compared with the n/sup 3/D states of helium shows that details of the excitation process itself play an important role in determining the angular dependence of <Lsub(perpendicular)>. As is also the case for excitation of the nsup(1,3)P states, the electron impact coherence parameters for excitation of the nsup(3,1)D states are predicted to be essentially independent of the principal quantum number.

16527 **Reduction of 1+1 REMPI spectra to population distributions: Saturation and intermediate state alignment effects.** Jacobs, D.C.; Madix, R.J.; Zare, R.N. (Department of Chemistry, Stanford University, Stanford, CA 94305). *AIP (American Institute of Physics) Conference Proceedings;* 160: No. 1, 364-370(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

A two-step methodology is presented for extracting ground state population distributions from 1+1 resonance enhanced multiphoton ionization (REMPI) spectra. In the first step the ion signal is corrected for variation with laser intensity as it is collected, generating an iso-power spectrum. In the second step populations and alignments are derived from the iso-power spectrum by correcting for the interdependent effects of saturation and intermediate state alignment. This procedure is applied to a room temperature thermal distribution of nitric oxide using the 1+1 REMPI process in which lines of the NO A $^2\Sigma^+$—X ^{2}Pi (0, 0) band constitute the resonant transition. The present treatment is able to recover the known rovibrational population distribution, independent of branch choice, over a wide range of practical operating conditions.

16528 **Laser absorption and fluorescence studies of the lithium 2s-3D transition.** Tisone, G.C.; Hargis P.J. Jr. (Sandia National Laboratories, Albuquerque, NM 87185). *AIP (American Institute of Physics) Conference Proceedings;* 160: No. 1, 404-407(25 Sep 1987). (CONF-861038—). Contract AC04-76DP00789.

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

Laser absorption and fluorescence spectroscopy were used to study the single-photon dipole-forbidden $2s^2S$ to $3d^2D$ transitions in lithium at 319.6 nm and the two-photon allowed transition between the two same levels at a wavelength of 639.2 nm.

16529 **Dynamics of cluster dissociation.** Keesee, R.G.; Castleman A.W. Jr. (The Pennsylvania State University, University Park, PA 16802). *AIP (American Institute of Physics) Conference Proceedings;* 160: No. 1, 458-464(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

The dynamics of dissociation of clusters induced by multiphoton ionization (MPI) is examined by time-of-flight mass spectrometry with the aid of a reflecting electric field. The systems discussed include ammonia, methanol, xenon, and p-xylene(Ar)/sub n/ clusters. Ammonia and methanol clusters undergo rapid intracluster reactions to yield protonated clusters. Much of the excess energy which leads to dissociation in ammonia, methanol, and xenon clusters results from the energy differences in the ground states of the neutral and ionic systems. On the other hand, in the case of p-xylene(Ar)/sub n/ the energetic differences are much smaller, so that the excess absorbed photon energy may be an important contribution.

16530 **Calculation of the electron impact coherence parameters for excitation of the 3/sup 1/D state of helium.** Cartwright, D.C.; Csanak, G. (Los Alamos National Lab., NM, USA). *J. Phys., B (London);* 20: No. 17, L583-L590(14 Sep 1987).

First-order many-body theory (FOMBT) has been used to calculate the differential cross sections (DCS) and electron impact coherence parameters (EICP) associated with excitation of the 3/sup 1/P, 3/sup 1/D and 3/sup 3/D states of helium for incident electron energies of 30, 40, 45 and 60 eV. No direct measurements of the DCS for excitation of the individual 3/sup 1/P, 3/sup 1/D and 3/sup 3/D states have been reported but the sum of the theoretical DCS for excitation of these three states is in excellent agreement with that determined from recent electron energy loss data at 30 eV. The EICP predicted by FOMBT for excitation of the 3/sup 1/D state are in good agreement with the recent measurements of previous workers but differ from those obtained using the multichannel eikonal approximation.

16531 **Multiphoton ionization of krypton and xenon: An investigation of the autoionizing region between the P/sub 1/2/ and P/sub 3/2/ thresholds.** Stockdale, J.A.D.; Efthimiopoulos, T.; Fotakis, C.; Blazewicz, P.R. (Chemical Physics Section, Health and Safety Research Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 236-238 of High intensity laser processes. Alcock, A.J. Bellingham, WA; SPIE (1986). (CONF-860620—). Contract AC05-84OR21400.

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

Four- and five-photon ionization of krypton has been investigated in the autoionizing region between the P/sub 1/2/ and P/sub 3/2/ ionization limits with a high-powered pulsed tunable dye laser and a static ionization cell. For the four-photon case, the np' and nf' Rydberg series leading to the P/sub 1/2/ limit were observed for n values 10-14 (p') and 7-18 (f'). The measured term values are compared with available earlier results. Quantum defects and ionization limits have been obtained. No new atomic structure was observed in the five-photon scans in krypton or in limited three-photon scans in xenon.

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REFER ALSO TO CITATION(S) 16510

16532 **(CEA-SPSRM-RA—1983-86) 1983-1986: progress report of the solid physics and magnetic resonance service.** (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). 1987. 322p. (In French). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751575/JAW.

The different activities are presented group by group; This reports four year activities. The different themas which do not appear (or not clearly) in the following key words are theoretical studies, helium 3 physics at very low temperature, static magnetism, and very low temperature magnetism, the quantronics, Moessbauer spectroscopy, inelastic scattering of light, two-dimensional physics, amorphous metallic alloys, material development and numerical methods.

16533 **(DOE/ER/13174—T8) Fully Lagrangian Renormalized Approximation theory of fluid turbulence: Progress report.** Frieman, E.A.; Hagan, W.K. (Science Applications International Corp., La Jolla, CA (USA)). 1988. Contract AC03-84ER13174. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004960/JAW.

The purpose of this paper is to discuss our refinement and extension of the work of Y. Kaneda on a Lagrangian Renormalized Approximation (LRA) for homogeneous hydrodynamic turbulence.

Kaneda's results are important to the development of a consistent theory of turbulence because the LRA theory successfully overcomes the failure of other turbulence theories (namely the Direct Interaction Approximation) to predict the Kolmogorov wavenumber spectrum. It is thought that this success is due to the use of a Lagrangian rather than Eulerian description of the fluid so that convection of the small eddies by the large ones is properly treated. However, some aspects of these results are puzzling and are considered here. For example, the form of the correlation function and the value of the Kolmogorov constant, K, depend on the choice of the form of the correlation function.

16534 (INIS-BR—748, pp 76) **Bec model-treatments of mean field (Curie-Weiss version) and renormalization group.** Henriques, V.B.; Salinas, S.R.A.; Carneiro, C.E.I. (Sao Paulo Univ., Brazil; Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16535 (INIS-BR—748, pp 102) **SAXS of liotropic liquid crystals.** Bittencourt, D.R.S. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16536 (INIS-BR—748, pp 103) **Possible deformation of a ferrocollesteric liquid crystal induced by chiral agent.** Figueiredo Neto, A.M.; Levelut, A.M.; Liebert, L.; Galerne, Y. (Sao Paulo Univ., Brazil; Paris-6 Univ., 75, France). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16537 (INIS-BR—748, pp 182) **Ground state energies of electron quantum liquid in quantized hall effect.** Cohen, A.M.; Studart, N. (Sao Paulo Univ., Sao Carlos, SP, Brazil; Sao Carlos Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

16538 (SAND—87-2745C) **A coupled viscid-inviscid calculation method for the prediction of unsteady separated flows over an airfoil.** Im, B.J.; Oler, J.W.; Strickland, J.H. (FloWind Corp., Pleasanton, CA (USA); Texas Tech Univ., Lubbock (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-880139—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003391/JAW.

From 26. AIAA aerospace conference; Reno, NV, USA (10 Jan 1988).

A coupled viscid-inviscid aerodynamic model ADAM2 (Advanced Dynamic Airfoil Model in 2 dimensions) is utilized to predict separated and unseparated flows over airfoils in steady and unsteady motion. Calculation results include pre- and post-stall pressure distributions, lift and drag, and trailing wake geometries for airfoils with a constant angle of attack, sinusoidally varying angle of attack, and constant rate pitching to large angles of attack. The principal difficulty yet to be overcome is the detailed representation of the viscid-inviscid interactions in the immediate vicinity of the boundary layer separation point. A persistent feed-back effect has been observed in which the presence of the separated wake surface causes the position of the boundary layer separation point to move progressively toward the leading edge. 10 refs., 10 figs.

16539 (UCRL—15983) **Analytical and numerical analysis of finite amplitude Rayleigh-Taylor instability.** Meiron, D.I.; Saffman, P.G. (California Inst. of Tech., Pasadena (USA). Dept. of Applied Mathematics). 18 Sep 1987. Contract W-7405-ENG-48. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004056/JAW.

We summarize the results obtained in the last year. These include a simple model of bubble competition in Rayleigh-Taylor unstable flows which gives results which are in good agreement with experiment. In addition the model has been compared with two dimensional numerical simulations of inviscid Rayleigh-Taylor instability using the cloud-in-cell method. These simulations can now be run into the late time regime and can track the competition of as many as ten bubbles. The improvement in performance over previous applications of the cloud-in-cell approach is due to the application of finite difference techniques designed to handle shock-like structures in the vorticity of the interface which occur at late times. We propose to extend the research carried thus far to Rayleigh-Taylor problems in three dimensional and convergent geometries as well as to two-fluid instabilities in which interface roll-up is observed. Finally we present a budget for the fiscal year 1987-1988. 6 refs.

16540 **Nuclear spin-lattice relaxation in ^{3}He-^{4}He mixtures.** Lowe, M.; Hammel, P.C.; Ecke, R.E.; Bedell, K.; Takigawa, M. (Group P-10, MS K764 Los Alamos National Laboratory, Los ALamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **37**: No. 4, 2281-2284(1 Feb 1988).

Spin-lattice relaxation times T_1 in ^{3}He-^{4}He solutions have been measured at temperatures between 1.5 and 3.3 K and for molar concentrations of 10%, 1%, and 0.1%. Little concentration dependence was observed. Below the lambda point, T_1 increases rapidly with increasing temperature; above, it is fairly constant. The data are well described by a wall relaxation mechanism, in which T_1 depends upon the time for the ^{3}He spins to diffuse to the walls. We discuss a theory for diffusion in dilute solutions at high temperatures where the diffusion coefficient is primarily determined by ^{3}He-roton scattering.

16541 **Nonlinear unstable viscous fingers in Hele—Shaw flows. I. Experiments.** Kopf-Sill, A.R.; Homsy, G.M. (Department of Chemical Engineering, Stanford University, Stanford, California 94305). *Physics of Fluids;* **31**: No. 2, 242-249(Feb 1988).

Post-instability viscous fingering in rectilinear flow in a Hele—Shaw cell has been studied experimentally. Of particular interest was the characterization of the range of length scales associated with tip splitting, over a reasonably wide range of parameters. A digital imaging system was used to record the patterns as a function of time, which allowed properties such as the tip velocity, finger width, perimeter, and area to be studied as functions of time and capillary number. The tip velocity was observed to be approximately constant regardless of the occurrence of splitting events, and the average finger width decreased as the degree of supercriticality increased. Quantitative measures of the fact that there is a limit to the complexity of viscous fingers are provided, and that over the range of parameters studied, no evidence for fractal fingering exists. A discussion of the dynamics of tip splitting explains why this is so.

16542 **Experimental test of the perturbation expansion for the Taylor instability at various wavenumbers.** Heinrichs, R.M.; Cannell, D.S.; Ahlers, G.; Jefferson, M. (Department of Physics, University of California, Santa Barbara, California 93106). *Physics of Fluids;* **31**: No. 2, 250-255(Feb 1988).

Measurements of the Fourier components of the axial variation of the velocity component w in a Taylor—Couette apparatus containing ten pairs of vortices at various average wavenumbers q, as a function of ϵequivalentR/R/sub c/-1, are reported. For all values of q studied, excellent agreement with the perturbation expansion of Davey [J. Fluid Mech. 14, 336 (1962)] for the amplitudes of the Fourier components was obtained, provided the power law dependence on ϵ was taken as a function of epsilon-tildeequivalentϵ-ϵ/sub m/(q). Here ϵ/sub m/(q) is the marginal stability curve,

below which the laminar flow state is stable against perturbations of wavenumber q. The wavenumber dependence of the leading coefficients in the expansions for the fundamental and first harmonic was also measured, and it was found that while the coefficient for the fundamental was independent of q, the coefficient for the first harmonic monotonically decreased with increasing q, over the range studied.

16543 **Analysis and computer simulation of confined ring vortices driven by falling sprays.** Marx, K.D. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94550). *Physics of Fluids;* 31: No. 2, 263-277(Feb 1988).

When a liquid spray is injected into the upper region of a closed container, it will entrain air as it falls to the bottom under the influence of gravity. In some cases, the resulting flow field assumes the form of one or more large ring vortices. In this paper, the droplet drag mechanism by which this systematic motion is sustained in steady state is studied theoretically and numerically. It is shown that the structure of the airflow is approximately that of a solution to the inviscid fluid equations. The airflow velocity is determined by the equilibrium of energy exchanged between the air and the spray in different regions of the flow. A simple formula for estimating the order of magnitude of the flow velocity is derived. Numerical calculations that solve for the coupled flow of the gas and the interacting spray are presented for cases of practical interest. The effect of varying the droplet diameter distribution and the mass flow rate of the spray is investigated.

16544 **Fluids in micropores. II. Self-diffusion in a simple classical fluid in a slit pore.** Schoen, M.; Cushman, J.H.; Diestler, D.J.; Rhykerd C.L. Jr. (Departments of Agronomy and Chemistry, Purdue University, West Lafayette, Indiana 47907). *Journal of Chemical Physics;* 88: No. 2, 1394-1406(15 Jan 1988).

Self-diffusion coefficients D are computed for a model slit pore consisting of a rare-gas fluid confined between two parallel face-centered cubic (100) planes (walls) of rigidly fixed rare-gas atoms. By means of an optimally vectorized molecular-dynamics program for the CYBER 205, the dependence of D on the thermodynamic state (specified by the chemical potential μ, temperature T, and the pore width h) of the pore fluid has been explored. Diffusion is governed by Fick's law, even in pores as narrow as 2 or 3 atomic diameters. The diffusion coefficient oscillates as a function of h with fixed μ and T, vanishing at critical values of h, where fluid—solid phase transitions occur. A shift of the pore walls relative to one another in directions parallel with the walls can radically alter the structure of the pore fluid and consequently the magnitude of D. Since the pore fluid forms distinct layers parallel to the walls, a local diffusion coefficient D/sup (//sup i//sup)//sub parallel/ associated with a given layer i can be defined. D/sup (//sup i//sup)//sub parallel/ is least for the contact layer, even for pores as wide as 30 atomic diameters (~100 A). Moreover, D/sup (//sup i//sup)//sub parallel/ increases with increasing distance of the fluid layer from the wall and, for pore widths between 16 and 30 atomic diameters, D/sup (//sup i//sup)//sub parallel/ is larger in the center of the pore than in the bulk fluid that is in equilibrium with the pore fluid. The opposite behavior is observed in corresponding smooth-wall pores, in which the discrete fluid—wall interactions have been averaged by smearing the wall atoms over the plane of the wall.

16545 **Liquid-metal magnetohydrodynamic acoustic transducer.** Swift, G.W. (Condensed Matter and Thermal Physics Group, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of the Acoustical Society of America;* 83: No. 1, 350-361(Jan 1988).

The properties of a liquid-metal magnetohydrodynamic acoustic power transducer have been both calculated and measured. The calculations are based on linearized Navier—Stokes and Maxwell's equations, and include Ohmic and viscous dissipation in the liquid metal. The measurements were made with liquid sodium at frequencies of about 1 kHz in a channel much larger than the viscous penetration depth but comparable in size to the electromagnetic skin depth. Calculated and measured quantities are in good agreement, indicating a quantitative understanding of this transducer. It converts acoustic power to electric power with 45% efficiency; substantially higher efficiencies appear possible with a slightly modified design.

16546 **Magnetohydrodynamic flow in a curved pipe.** Issacci, F.; Ghoniem, N.M.; Catton, I. (Mechanical, Aerospace, and Nuclear Engineering Department, University of California at Los Angeles, Los Angeles, California 90024). *Physics of Fluids;* 31: No. 1, 65-71(Jan 1988).

The flow of conductive fluids in highly conductive curved pipes is studied analytically in this paper. The flow is assumed to be steady state, laminar, and fully developed. Coupled continuity, Navier—Stokes, and appropriate Maxwell equations are solved in toroidal coordinates. The dimensionless parameters of the problem are Dean number K and Hartmann number Ha. For low Hartmann numbers [$Ha^2 \sim \theta(1)$], the solution is expanded in a power series of K and Ha^2. For intermediate Hartmann numbers [$Ha^2 \sim \theta(1000)$], the solution is expressed as a power series of K. The axial velocity contours are shown to be shifted towards the outer wall. For low Ha, these contours are nearly circular. The effect of a strong transverse magnetic field is to enhance the compression of fluid towards the outer wall. The secondary flow field comprises a symmetric pair of counter-rotating vortices. A strong magnetic field is found to confine the secondary flow streamlines to a thin layer near the tube wall. The secondary flow rate in the near-wall boundary layer is increased by the magnetic field. This increase in flow rate raises the possibility of efficient convective cooling of curved first wall tubes in magnetic confinement fusion reactors (MFCR).

16547 **Path-integral computation of superfluid densities.** Pollock, E.L.; Ceperley, D.M. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review* [*Section*] *B: Condensed Matter;* 36: No. 16, 8343-8352(1 Dec 1987).

The normal and superfluid densities are defined by the response of a liquid to sample boundary motion. The free-energy change due to uniform boundary motion can be calculated by path-integral methods from the distribution of the winding number of the paths around a periodic cell. This provides a conceptually and computationally simple way of calculating the superfluid density for any Bose system. The linear-response formulation relates the superfluid density to the momentum-density correlation function, which has a short-ranged part related to the normal density and, in the case of a superfluid, a long-ranged part whose strength is proportional to the superfluid density. These facts are discussed in the context of path-integral computations and demonstrated for liquid ^{4}He along the saturated vapor-pressure curve. Below the experimental superfluid transition temperature the computed superfluid fractions agree with the experimental values to within the statistical uncertainties of a few percent in the computations. The computed transition is broadened by finite-sample-size effects.

16548 **Dynamics of quantum liquids at high momentum.** Tanatar, B.; Talbot, E.F.; Glyde, H.R. (Department of Physics, University of Delaware, Newark, Delaware 19716). *Physical Review* [*Section*] *B: Condensed Matter;* 36: No. 16, 8376-8392(1 Dec 1987).

The dynamic form factor S(Q,ω) in liquid ^{3}He and ^{4}He is evaluated in the wave-vector transfer range 3≦Q≦15 A/sup -1/. The input is the pair interatomic potential, developed by Aziz et al. The S(Q,ω) is calculated within the random-phase approximation (RPA) which becomes valid when h-dash-barQ is much larger than the average momentum in the liquid. A T-matrix approximation represents the interaction appearing in the RPA. The aim is to explore how well S(Q,ω) can be described for 3≦Q≦15 A/sup -1/ from first principles. In ^{3}He, we find S(Q,ω) is a broad, nearly Gaussian function, centered just below the recoil frequency having a width and shape that agrees well with experiment. It does, however, have tails at high frequency which make important contributions to its moments. In ^{4}He, S(Q,ω) is a more sharply peaked function which also agrees quite well with experiment. We are able to reproduce the oscillations in the peak position and in the width of S(Q,ω) with Q in liquid ^{4}He observed by Martel et al. In the present model, these oscillations originate from oscillations in the magnitude of the T-matrix interaction with Q. The corresponding

oscillations are predicted to be very small and probably unobservable in liquid ^{3}He.

16549 **Redesign of a supercritical wing in the presence of an engine nacelle.** Ross, D.S. (Courant Institute of Mathematical Sciences, New York, New York 10012). *Journal of Computational Physics;* **73**: No. 2, 233-243(Dec 1987).

A method for modelling an engine nacelle in a compressible flow using a source distribution is described. The incorporation of this technique into a free boundary supercritical wing design code is discussed. Results of calculations made with this code are presented. A method for calculating wave drag is also described. copyright 1987 Academic Press, Inc.

16550 **Convective flux limiter for non-Lagrangian computational fluid dynamics.** Cloutman, L.D. (Theoretical Division, Group T-3, University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Computational Physics;* **73**: No. 2, 349-363(Dec 1987). Contract W-7405-ENG-36.

The rezoning phase of the ALE method models the advection terms in the Navier—Stokes equations. Consequently, this method suffers from all the numerical difficulties associated with these terms, except when it is used for pure Lagrangian calculations. In particular, the use of any of the differencing options presently available in the CONCHAS-SPRAY computer program other than pure donor cell can create artificial oscillations in the solution through the dispersive truncation errors. This paper describes a flux-limiting procedure that suppresses these oscillations by locally adding enough donor-cell differencing to prevent nonphysical growth of local maxima and minima. Numerical solutions from CONCHAS-SPRAY illustrate the effectiveness of this algorithm. copyright 1987 Academic Press, Inc.

16551 **On the orientational properties of some one-dimensional model systems.** Lebowitz, J.L.; Percus, J.K.; Talbot, J. (Departments of Mathematics and Physics, Rutgers University, New Brunswick, New Jersey 08903). *Journal of Statistical Physics;* **49**: No. 5, 1221-1234(Dec 1987).

We use the transfer matrix formalism to examine the behavior of some anisotropic hard-core fluids, the centers of whose particles are constrained to a line. At large elongation and pressure, the compressibility factor βp/rho is higher than that for a system with complete alignment by a factor $1+\nu$ that depends upon the molecular geometry. For molecules with a finite radius of curvature, e.g., ellipses, $\nu = d/2$, while for objects with flat sides $\nu = d$; here d is the number of orientational degrees of freedom. A connection is made to some recent studies of hard ellipsoid fluids. We also model the effect of an external field on physical adsorption and show the existence of a phase transition in certain limiting situations.

16552 **Application of a laser-induced breakdown time-of-flight technique as a flow diagnostic in a CO_2 free-jet expansion.** Wantuck, P.J.; Hof, D.E. (Chemical and Laser Sciences Division, Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 676-679(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

A time-of-flight velocity technique utilizing ions formed by the process of laser induced (1.064 μm) breakdown has been used to measure axial flow speeds in a CO_2 free-jet expansion. For the nozzle stagnation pressure and temperature employed ($p_0 \approx 200$ torr, $T_0 \approx 298$K), the axial flow speed is on the order of 630 m/s.

6450 High Energy Physics

16553 **(BNL—40400) Non-accelerator experiments.** Goldhaber, M. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 5p. (CONF-860701—94). NTIS, PC A02. Order Number DE88002886/JAW.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

This report discusses several topics which can be investigated without the use of accelerators. Topics covered are: (1) proton decay, (2) atmospheric neutrinos, (3) neutrino detection, (4) muons from Cygnus X-3, and (5) the double-beta decay.

16554 **(INIS-SU—428) JINR rapid communications.** Collection. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 79p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780044/JAW.

Individual papers in this collection are abstracted individually. (LEW)

16555 **(LA—11177-C) Proceedings of the LAMPF workshop on photon and neutral meson physics at intermediate energies.** Baer, H.W.; Crannell, H.; Peterson, R.J. (eds.). (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 494p. (CONF-870158—). NTIS, PC A21/MF A01; GPO Dep. Order Number DE88004703/JAW.

From Workshop on proton and neutral meson physics at intermediate energies; Los Alamos, NM, USA (8 Jan 1987).

This volume contains the Proceedings of the Workshop on "Photon and Neutral-Meson, Physics at Intermediate Energies," held at Los Alamos, New Mexico, January 7 to 9, 1987. The purpose of this workshop was to bring together scientists working in the areas of electromagnetic, heavy-ion, and light hadron physics to discuss both the physics that could be addressed and potential capabilities of new, large intermediate-energy photon detectors. Based on the papers contained in these proceedings, it appears clear that there are a number of important areas that could be addressed with a much higher resolution neutral meson detector. It is also clear that the technical capability for building a neutral meson detector for energies up to 4 GeV with solid angle of approximately 10 mrs and resolution of a few hundred keV now exists. It also appears entirely reasonable to construct such a detector to be easily transportable so that it would become a national facility, available for use at a number of different laboratories. From the many interesting papers presented and from the broad representation of physicists from laboratories in Asia, Canada, Europe, Japan, and the United States, there appears to be a strong case for proceeding with the construction of such a detector.

16556 **The experimental foundations of particle physics.** Cahn, R.N.; Goldhaber, G. New York, NY; Cambridge University Press (1987). 400p. Cambridge University Press, 32 East 57 St., New York, NY 10022.

This book describes the development of modern particle physics, emphasizing the role and significance of crucial experiments. This description is supported by a selection of reprints of notable experimental papers. Beginning at the turn of the century with the discovery of radioactivity, x-rays, and the Thomson model of the atom, the authors take the reader through the great developments of the twentieth century, culminating in a description of the electroweak theory and the discovery of the W and Z vector bosons. The bulk of this book is written in non-technical language, although more technical passages are included and extensive references to review articles and books are given.

16557 **Computing in high energy physics.** Ash, W. (ed.). Amsterdam, The Netherlands; North-Holland Physics Publishing (1987). 480p. Elsevier Sci. Publ., P.O. Box 103, 100 AC Amsterdam, The Netherlands. Order Number TI88002810/JAW. Contract AC03-76SF00515.

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

This book contains papers presented at the conference of Computing in High Energy Physics. Some of the topics covered in this book are: the use of multiprocessors, expert systems for Fastbus diagnosis, computer networking, Monte Carlo computer simulation of cascade showers, computer graphic analysis, use of personal computers, programming languages, database systems, parallel processing of Monte Carlo calculations on microcomputer and many more related topics. Separate abstracts were prepared for 59 papers in these proceedings. (LSP)

16558 Why develop programs differently than current HEP practice. Linnemann, J.T. (Michigan State Univ., East Lansing, MI). pp 325-337 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

Current industrial program development practice is reviewed and its relevance to high energy physics is discussed. The experience of DO with these techniques is commented on, and a selected bibliography provided.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 15872, 16233, 16365, 16694, 16700, 16781, 16819, 16836, 16857, 16976, 17153

16559 (BNL—40399) Proton decay: The search goes on. Goldhaber, M. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 3p. (CONF-8709211—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003546/JAW.

From Conference in honor of Sir Denys Wilkinson; Brighton, UK (6 Sep 1987).

In the search for proton decay the results of the IMB detector taken together with results from other detectors have reached a limit for the proton decay branch $p \rightarrow e^+ \pi^0$ which is nearly a thousand times longer than the most probable value predicted by the minimal SU(5) theory. Other grand unified theories give no quantitative prediction, and the search continues now as a purely experimental challenge. In the meantime, supernova explosions in our galaxy could also be recorded. 8 refs.

16560 (BNL—40491) Status and first results of BNL experiment 777: A search for $K^+ \rightarrow \pi^+ \mu^+ e^-$ and a study of $K^+ \rightarrow \mu^+ e^+ e^-$. Baker, N.J.; Gordon, H.A.; Lazarus, D.M.; Polychronakos, V.A.; Rehak, P.; Tannenbaum, M.J.; Egger, J.; Herold, W.D.; Kaspar, H.; Chaloupka, V. (Brookhaven National Lab., Upton, NY (USA); Swiss Inst. for Nuclear Research, Villigen; Washington Univ., Seattle (USA). Dept. of Physics). 1 Oct 1987. Contract AC02-76CH00016. 18p. (CONF-870821—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003492/JAW.

From SLAC summer institute on particle physics; Stanford, CA, USA (10 Aug 1987).

Results of our search for short lived neutral particles emitted in K^+ decay are given. We also seek to make an accurate measurement of the branching ratio for $\pi^0 \rightarrow e^+ e^-$ by looking for the decay chain $K^+ \rightarrow \pi^+ \pi^0$, $\pi^0 \rightarrow e^+ e^-$. The world average branching ratio for this decay is $(1.8 \pm 0.7) \times 10^{-7}$ based on about 30 events from two experiments. Theory predicts that this branching ratio should be of order 6×10^{-8}. If the branching ratio remains at the 2×10^{-7} level when measured with smaller errors, this could be an indication of new physics. 24 refs., 7 figs.

16561 (CERN-EP—87-15) Results on θ/sub w/ from the CERN high-energy neutrino experiments or: Why θ/sub w/? How θ/sub w/?. Barbiellini, G. (European Organization for Nuclear Research, Geneva (Switzerland); Istituto Nazionale di Fisica Nucleare, Frascati (Italy). Lab. Nazionale di Frascati). 22 Jan 1987. 28p. (CONF-860736—17). NTIS, PC A03/MF A01. Order Number DE88900042/JAW.

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

This paper considers methods of measuring θ/sub w/. It discusses how θ/sub w/ is determined from neutrino-electrons and neutrino-nucleon scattering and the detectors used to detect the neutrinos. Experimental results and data analyses are also discussed. 5 refs., 24 figs., 5 tabs. (LSP)

16562 (CONF-870121—13) Production of the charmed strange baryon Ξ/sub c/$^+$ by neutrons. (Colorado Univ., Boulder (USA); Illinois Univ., Urbana (USA). Dept. of Physics; Fermi National Accelerator Lab., Batavia, IL (USA); Bologna Univ. (Italy). Dipartimento di Fisica; Milan Univ. (Italy). Ist. di Fisica; Istituto Nazionale di Fisica Nucleare, Milan (Italy)). Dec 1986. Contract AC02-76ER01195;AC02-76CH03000. 21p. (COLO-HEP—140). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005210/JAW.

From Meeting of the Division of Particles and Fields of the American Physical Society; Salt Lake City, UT, USA (14 Jan 1987).

We report on the observation of a narrow resonance at a mass of 2450 MeV/c^2 in the final states $\Lambda K^- \pi^+ \pi^+$ and $\Sigma^0 K^- \pi^+ \pi^+$. The mass, width, lifetime, and decay modes support the interpretation of a hadronically produced charm-strange baryon, the Ξ/sub c/$^+$. We present our preliminary measurements of the lifetime, and the Λ, x/sub feynman,/ and p/sub t/ dependence of the state.

16563 (CONF-870632—11) Measurement of the photon structure function F_2/sup gamma/(x,Q^2) between $10 \leq Q^2 \leq 60$ GeV^2. Aihara, H.; Alston-Garnjost, M.; Avery, R.E.; Barbaro-Galtieri, A.; Barker, A.R.; Barnett, B.A.; Bauer, D.A.; Bengtsson, H.U.; Bobbink, G.J.; Bolognese, T.S. (Massachusetts Univ., Amherst (USA); Lawrence Berkeley Lab., CA (USA); California Univ., Davis (USA); California Univ., Stanford (USA). Intercampus Inst. for Research at Particle Accelerators; California Univ., Los Angeles (USA); California Univ., Riverside (USA)). 1987. Contract AC02-85ER40194;AC03-76SF00098;W-7405-ENG-82. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004670/JAW.

From International Europhysics conference on high energy physics; Uppsala, Sweden (25 Jun 1987).

We present a measurement of the photon structure function F_2/sup γ/ in the reaction ee→eeX for Q^2 in the range $10 < Q^2 < 60$ GeV^2, using 285 multihadron events obtained with the TPC/Two-Gamma detector at PEP. The data have been corrected for detector effects using a regularized unfolding procedure. Using our previous low Q^2 measurements to estimate the hadronic component, we perform a QCD analysis at high Q^2 within the context of the regularisation scheme of Antoniadis and Grunberg. We obtain rather safe bounds on the value of the QCD scale parameter of $119 \pm 34 < \Lambda$/sub M-bar S-bar/ $< 215 \pm 55$ MeV.

16564 (DOE/ER/40036—7) Measurement of observables in the pion-nucleon system and investigation of charge symmetry in ^{3}H and ^{3}He: Progress report, 1 March 1987-1 December 1987. Sadler, M.E.; Isenhower, L.D. (Abilene Christian Univ., TX (USA)). 1 Dec 1987. Contract AS05-81ER40036. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004519/JAW.

This report describes the progress made in the past year and future plans for the pion scattering programs in which Abilene Christian University is collaborating. The experiments are conducted at the Clinton P. Anderson Meson Physics Facility at Los Alamos (LAMPF). The experiments are performed in collaboration with UCLA, George Washington University, LAMPF Groups MP-4, MP-10 and MP-13, and Catholic University. The measurements include: (1) a complete set of observables in the pion-nucleon system in the momentum interval 400 to 700 MeV/c, (2) differential cross sections at low energy for pion-nucleon charge exchange, and (3) elastic and inelastic scattering of π/sup +-/ on ^{3}H and ^{3}He.

16565 (DOE/ER/40257—003) Non-accelerator particle physics: Progress report, February 1, 1987-January 31, 1988. Steinberg, R.I. (Drexel Univ., Philadelphia, PA (USA). Dept. of Physics and Atmospheric Science). Jan 1988. Contract AC02-86ER40257. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005406/JAW.

The goals of this research are the experimental testing of fundamental theories of physics such as grand unification and the exploration of cosmic phenomena through the techniques of particle physics. We are currently engaged in construction of the

MACRO detector, an Italian-American collaborative research instrument with a total particle acceptance of 12,000 m²sr, which will perform a sensitive search for magnetic monopoles using excitation-ionization methods. Other major objectives of the MACRO experiment are to search for astrophysical high energy neutrinos expected to be emitted by such objects as Vela X-1, LMC X-4 and SN-1987A and to search for low energy neutrino bursts from gravitational stellar collapse. The past year has seen major progress in our program of liquid scintillator development. We now have an advanced scintillator formulation whose figure-of-merit for use in long counters (such as the MACRO counters) is double that of the previous best scintillator. The new formulation promises to enhance substantially the physics potential of the MACRO detector. Dr. Charles Lane (Ph.D. 1987, Caltech)l has now joined our group, resulting in significant expansion of our responsibilities on the MACRO experiment. We are now leaders of the American effort to develop the off-line data analysis for MACRO.

16566 **(FNAL/C—87/147-E) Charm hadroproduction results from Fermilab E-400.** Coteus, P.; Binkley, M.; Bossi, F.; Butler, J.; Cumalat, J.P.; DiCorato, M.; Diesburg, M.; Enagonio, J.; Filaseta, J.; Frabetti, P.L. (Colorado Univ., Boulder (USA); Illinois Univ., Urbana (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Bologna Univ. (Italy). Dipartimento di Fisica; Milan Univ. (Italy). Dipartimento di Fisica; Istituto Nazionale di Fisica Nucleare, Milan (Italy)). Sep 1987. Contract AC02-76CH03000. 13p. (CONF-8705198—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004032/JAW.

From 2. topical seminar on heavy flavour physics; San Miniato, Italy (25 May 1987).

Results are presented from Fermilab E-400 on the production of charmed baryons and mesons at a mean energy of 640 GeV. We show evidence for the charm-strange baryon, Ξ/sub c/⁺, and present our measurements of its mass, width, lifetime, cross section and relative branching fractions, and the A, x/sub f/, p/sub t/, and particle/antiparticle dependence of the state. We show evidence for both the Σ/sub c/²⁺ and Σ/sub c/⁰, and present measurements of three mass differences, Σ/sub c/²⁺ - Σ/sub c/⁰, Σ/sub c/⁰ - Λ/sub c/⁺, and Σ/sub c/²⁺ - Λ/sub c/⁺. Measurements of the A dependence and particle/antiparticle ratios for Σ/sub c/ production are also presented. We show preliminary results on the ratio of two decay modes of the D⁰, D⁰ → K⁺K⁻ and D⁰ → K₀anti K₀. The latter mode has not been previously observed. 8 refs., 10 figs.

16567 **(IAE—4266/2) Restrictions on the electromagnetic characteristics of antineutrinos in reactor experiment.** Ketov, S.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700175/JAW.

In the experiment at the Rovno NPP restrictions for magnetic momentum, charge radius and lifetime of antineutrino as to electromagnetic decay are obtained: μν-tilde/sub e/ < 3.7x10⁻⁹ μ/sub B/; √<r/sub ν-tilde(sub e)/²> <10⁻¹⁵ cm and tau/sub ν-tilde/⁰/m/sub ν-tilde/>(19-30) s/eV. Experimental restrictions obtained are very far from theoretical prodictions. 26 references, 2 tables.

16568 **(IFVE-OEIPK—86-177) Diffraction processes in the six-particle exclusive K⁺p reactions at 32 GeV/c.** Azhinenko, I.V.; Vorob'ev, A.P.; Amaglobeli, N.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700196/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

Study results of the diffraction processes in 6-body reactions K⁺p -> K⁺p2π⁺2π⁻, K⁺p -> K⁺pK⁺K⁻π⁺π⁻ and K⁺p -> K⁺ppp-barπ⁺π- at 32 GeV/c obtained in the Mirabelle bubble chamber experiment are presented. 10 references, 8 figures.

16569 **(IFVE-OEIPK—86-195) Inclusive production of γ quanta and π/sup 0/-mesons in p-barp interactions at 70 GeV/c.** Ukhanov, M.N.; Bogolyubskij, M.Yu.; Ivanova, N.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 12p. (In Russian). (CERN-WA—31-Ext). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700635/JAW.

Inclusive γ-quanta and π/sup 0/-meson production in the p-barp-experiment at 70 GeV/c has been studied. The experiment has been carried out in CERN on the BEBC chamber equipped with the track-sensitive target. The inclusive and topological cross sections as well as the estimations of ω/sup 0/- and eta/sup 0/-meson production cross sections are presented. π/sup 0/ and γ longitudinal and transverse momentum distributions are compared with the p-barp-data at 2.32, 100 GeV/c and pp-data at 69 GeV/c. 14 refs.; 10 figs.

16570 (IN2P3—86-01, pp 493-519) **Nucleon and nucleon-nucleon interaction in the Chiral symmetry model.** Loiseau, B. (Paris-11 Univ., 91 - Orsay, France. Inst. de Physique Nucleaire; Paris-6 Univ., 75, France). 1986. (In French). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751391/JAW. (CONF-8609338—).

From Joliot Curie school of nuclear physic: symmetries and nuclear physics; Maubuisson, France (15 Sep 1986).

We show how from the Skyrme model, which is modelling QCD at low energy and which is chiral symmetric, one can describe the nucleon and the nucleon-nucleon interaction. We briefly outline the lastest extensions to build low energy hadron physics from effective Lagrangians.

16571 **(INFN-LNF—87-22(P)) Open problems in e/sup +/e/sup -/ hadron production below 3 GeV.** Baldini Ferroli, R. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1987. 17p. (CONF-8702123—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701065/JAW.

From Hadronic physics at intermediate energy; Folgaria, Italy (1 Feb 1987).

The e/sup +/e/sup -/ annihilation into hadrons in the center of mass total energy region 1 to 3 GeV is shortly reviewed. The quark model and the color as quark internal number were strongly supported when the multihadronic production at these energies was discovered. The J/PSI properly defines an upper limit opening a new kind of physics but, just for its different nature and for the high production cross section (about 50*mb radiative corrections included), it is also the best factory for the light quark spectroscopy. In the following the most relevant features of e/sup +/e/sup -/ annihilation at these energies are summarized from the point of view of conservation laws and theoretical expectations. Published data are reviewed with some antipation on the DM2 new results. Open problems are emphasized, also if few chances exist they will ever be solved. 27 refs.

16572 **(INIS-mf—10789) Measurement of the total cross section for deep inelastic neutrino-iron and antineutrino-iron reactions with charge exchange.** Keilwerth, H. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1986. 118p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751518/JAW.

The cross section for deep inelastic neutrino-iron and antineutrino-iron charge-exchange reactions was determined. The experiment was performed in the CERN-NBB at hadron beam momenta of 100 GeV/c, 160 GeV/c, and 200 GeV/c with both polarities. The events were registrated with the improved CDHS detector. The flux determination ensued indirectly via the measurement of the hadron flux respectively the muon flux. The neutrino flux determined by both methods agrees well. Within the accessible neutrino energy range (10 GeV < E/sub ν/ < 200 GeV) no significant deviation from the linear growth of the cross section with the energy is recognizable. Averaged over the whole neutrino energy range following results are obtained: σ sub(anti ν)/E/sub ν/ = 0.331 +- 0.003 +- 0.009 (. 10/sup -38/ cm/sup 2/ (nucl. . GeV)/sup -1/), σ/sub ν//E/sub ν/ = 0.703 +- 0.002 +- 0.019 (. 10/sup -38/ cm/

sup 2/ (nucl. . GeV)/sup -1/), and σ sub(anti ν)/σ/sub ν/ = 0.471 +- 0.005 +- 0.007. The first error indication means the statistical, the second the systematical error. The systematic error is mainly conditioned by uncertainties in the flux determination. (orig./HSI).

16573 **(INIS-mf—10791) Measurement of neutral hadronic transitions of the Y(2S) into the Y(1S) resonance with the Crystal Ball detector at DESY.** Lurz, B. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Naturwissenschaftliche Fakultaet 1 - Mathematik und Physik). 26 Mar 1986. 156p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751520/JAW.

In this thesis neutral hadronic transitions from the Y(2S) to the Y(1S) resonance are investigated. The analysis is based on approximately 193 000 Y(2S) decays taken from 1982 to 1984 with the Crystal Ball detector at the DORIS e/sup +/e/sup -/ storage ring of the Deutsches Elektronen Synchrotron (DESY) in Hamburg, West Germany. The π/sup 0/π/sup 0/ transition with the $\gamma\gamma\gamma\gamma$ Final state, the eta transition with the $\gamma\gamma$ and the $\gamma\gamma\gamma\gamma\gamma\gamma$ (from the decay eta -> π/sup 0/π/sup 0/π/sup 0/) final states, and also the isospin forbidden single π/sup 0/ transition with the $\gamma\gamma$ final state are investigated in detail. In the subsequent decay of the Y(1S) the exclusive decays into e/sup +/e/sup -/ or μ/sup +/μ/sup -/ are considered. Assuming lepton universality and using the present world average of B/sub $\mu\mu$/(Y(1S)) the analysis results in a branching ratio for the π/sup 0/π/sup 0/ transition of B(Y(2S) -> π/sup 0/π/sup 0/ Y(1S)) = (8.3 +- 1.0 +- 1.2)%. The angular distributions of the decay products are consistent with those expected for the emission of a spin zero $\pi\pi$-system in a relative S-wave with the Y(1S). The invariant mass spectrum M/sub $\pi\pi$/ of the di-pion system peaks at high masses in agreement with theoretical expectations and with other measurements of the $\pi\pi$ transition, especially the π/sup +/π/sup -/ transition. For the branching ratio of the eta transition one obtains an upper limit of B(Y(2S) -> etaY(1S)) < 0.60% (90% CL). The single π/sup 0/ transition results in an upper limit of B(Y(2S) -> π/sup 0/ Y(1S)) < 0.50% (90% CL).

16574 **(ITEF—8(1986)) Proton and deuteron production at 135 deg +- 6 deg angle in inclusive reaction on carbon nucleus by action of π^- mesons with 0.85-2.5 GeV/c momenta.** Burgov, N.A.; Gerzon, S.A.; Kiselev, Yu.T. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700249/JAW.

Data on proton and deuteron energy spectra at the angles 135 deg +- 6 deg in inclusive πC -> p(d)X reactions at incident pion momentum 0.85, 1.0, 1.5, 2.0, 2.5 GeV/c are presented. The possibility to investigate low-nucleon clusters in the nucleus at studying incident hadron energies is discussed. 7 references, 6 figures.

16575 **(JINR-R—1-86-725) Attempt to observe relativistic variation of space dimensions of interaction region in p-barp reactions of multiple production.** Strel'tsov, V.N.; Glagolev, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700266/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

By the method of interference of identical pions space dimensions of interaction region (region of pion generation) in p-barp-collisions at 22.4 GeV/c in different reference frames are determined. As earlier for π^- p-interactions, an indication of the relativistic increase of longitudinal dimensions of interaction region from the center-of-mass system to laboratory reference frame is obtained. 16 references, 2 tables.

16576 **(LA—11182-T) Study of neutrino-electron scattering at LAMPF.** Potter, M.E. (Los Alamos National Lab., NM (USA)). Jan 1988. Contract W-7405-ENG-36. 178p. Univ. of California, Campus Drive, Irvine, CA 92717. Order Number TI88004699/JAW.

Using a beam stop source of ν/sub e/ from stopped mu^+ decay located at the Clinton B. Anderson Meson Physics Facility at the Los Alamos National Laboratory, a measurement of the reaction ν/sub e/ + e^- yields ν/sub e/ + e^- was performed. In the Weinberg-Salam-Glashow model of electroweak interactions, the above reaction is mediated both by the exchange of a Z boson (neutral-current) and the exchange of a W boson (charged-current), and is thus sensitive to the interference between these two exchanges. A total of 304 +- 49 ν/sub x/e events are identified of which 254 +- 50 are attributed to ν/sub e/e elastic scattering. The observed event rate rules out the opposite sign of the interference by 4.6σ and is consistent with the interference predicted by the WSG model. The measured cross-section is $\sigma(\nu$/sub e/e) = [11.8 +- 2.5(stat) +- 1.2(syst)] x 10^{-42} cm^2 x E/sub ν/(GeV) with a measured Weinberg angle of $\sin^2 \theta$/sub W/ = 0.31 +- 0.08(stat) +- 0.03(syst). 43 refs., 71 figs., 6 tbls.

16577 **(LAPP-EXP—86-07) Study of charmonium rare decays.** Brient, J.C. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Sep 1986. 236p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751417/JAW.

This thesis presents the study of rare decays of charmonium states formed in the interaction of an antiproton beam with an hydrogen gas jet target. Electromagnetic final states are used to sign the charmonium state formation (e/sup +/e/sup -/, e/sup +/e/sup -/ + CHI, $\gamma\gamma$). The selection of events used a two arms non magnetic spectrometer, with a charged track system, a threshold Cerenkov counter to tag the electron (positron), and an e.m. calorimeter. Energy scan technic have been used to observe the resonant formation through the excitation curves. Parameters of the states (mass, total and partial widths) are extracted from these curves using a statistical analysis. Two types of decays have been studied in this thesis: /sup 1/P/sub 1/ charmonium state decay to the psi (signed by its e/sup +/e/sup -/ decay). In the energy scan around the center of gravity of the P charmonium states, we observe a cluster of 5 events, in a narrow mass range. This cluster correspond to a 2.7 σ signal. The most probable interpretation of this signal is given by a narrow resonance, with a mass of 3526. MeV. Due to the properties (mass, width and decay) of this signal, this could be interpreted as the /sup 1/P/sub 1/ charmonium state. 2 photons decay of the eta/sub c/ and CHI/sub 2/. 22 $\gamma\gamma$ events are observed, 15 in the eta/sub c/ region, and 7 in the CHI/sub 2/ region. This sample is interpreted as a direct observation of eta/sub c/ and CHI/sub 2/ decay into $\gamma\gamma$. Parameters of these decays, ($\gamma\gamma$ partial width), are extracted using a maximum likelihood analysis. Theoretical models of charmonium explain correctly the properties of the charmonium, including the results presented in this thesis. 57 refs.

16578 **(LBL—24093) Aspects of B physics.** Gaillard, M.K. (Lawrence Berkeley Lab., CA (USA)). 14 Oct 1987. Contract AC03-76SF00098. 10p. (UCB-PTH—87/45; CONF-8709224—1). NTIS, PC A02. Order Number DE88003867/JAW.

From B-meson factory workshop; Stanford, CA, USA (8 Sep 1987).

Various aspects of weak decays are commented on. Probing of the standard model and of phenomena beyond the standard model are discussed, followed by a theoretical view of B mesons and some experimental observations on B mesons. The point is made that any data on B decay would be interesting in that it would provide powerful new constraints in analyses of the standard model and extensions thereof. (LEW)

16579 **(LBL—24208) Determination of alpha/sub s/ from energy-energy correlations in e^+e^- annihilation at 29 GeV.** Wood, D.R. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005271/JAW.

We have studied the energy-energy correlation in e^+e^- annihilation into hadrons at $\sqrt{s}$ = 29 GeV using the Mark II detector at PEP. We find to O(α/sub $s/^2$) that α/sub s/ = 0.158 +- .003 +- .008 if hadronization is described by string fragmentation. Independent fragmentation schemes give α/sub s/ = .10 - .14, and give poor agreement with the data. A leading-log shower fragmentation model is found to describe the data well.

16580 (RAL—86-073) Measurement of electroweak effects in e^+e^- annihilation. Saxon, D.H. (Rutherford Appleton Lab., Chilton (UK)). Jul 1986. 22p. (CONF-8605200—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750826/JAW.

From 9. Warsaw symposium on elementary particle physics; Kazimierz, Poland (26 May 1986).

Electroweak interference effects in $e^+e^- \rightarrow$ leptons have been measured to an accuracy of about 5%. This allows for accurate comparison with theory, and the differences between theoretical schemes are discussed, together with the sensitivity of limits on deviations from theory to normalisation systematics. The weak coupling is seen in the hadronic total cross-section and the Z^0 propagator in leptonic forward-backward asymmetries. The weak isospins of heavy quarks have been measured.

16581 (RAL—86-080) Measurement of the Dsub(s) meson lifetime by TASSO. Forden, G.E. (Rutherford Appleton Lab., Chilton (UK)). Aug 1986. 6p. (CONF-860701—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750897/JAW.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The lifetime of the Dsub(s) meson has been measured. The preliminary value is 3.4sub(-1.6)sup(+2.9) +- 0.7 x 10^{-13} sec. The method used was to fully reconstruct the decay vertex of the channel Dsub(s) $\rightarrow$ phiπ^{+-}; phi $\rightarrow K^+K^-$. The experiment is being performed with the TASSO detector at the e^+e^- storage ring PETRA. It is expected that this measurement will be updated with significantly increased statistics after the end of this year's running.

16582 (RAL—86-098) Aspects of experimental particle physics. McCubbin, N.A. (Rutherford Appleton Lab., Chilton (UK)). Nov 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750922/JAW.

The paper contains three lectures on Experimental Particle Physics which were given at the 16th British Universities Summer School for Theoretical and Elementary Particle Physics, Durham, 1986. The first lecture briefly reviews the physics which underpins all particle detectors, and the second lecture describes how this physics influences a modern detector. The last lecture is concerned with the topics of beams and computers, and includes the physics of stochastic cooling and the Halting theorem. (U.K.).

16583 (RAL—86-109) Measurement of the Dsub(s) lifetime. ; TASSO Collaboration. (Rutherford Appleton Lab., Chilton (UK)). Dec 1986. 8p. (DESY—86-159; WIS—86/66/Dec/PH). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750934/JAW.

The lifetime of the Dsub(s) meson has been measured using the TASSO detector at PETRA and found to be (3.7sub(-2.6)sup(+3.6) +- 0.9) x 10^{-13} sec. The method used was to reconstruct fully the decay vertex of the channel Dsub(s) $\rightarrow$ phiπsup(+-), phi $\rightarrow K^+K^-$.

16584 (RAL—87-001) Particle physics experiments 1986. Stuart, G.W. (comp.). (Rutherford Appleton Lab., Chilton (UK)). 1987. 219p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750944/JAW.

The paper presents research work carried out in 1986 on 52 elementary particle experiments approved by the Particle Physics Experiments Selection Panel. Most of the experiments were collaborative and involved research groups from different countries. About half of the experiments were conducted at CERN, the remaining experiments employed the accelerators: LAMPT, LEP, PETRA, SLAC, and HERA. The contents consist of unedited contributions from each experiment. (U.K.).

16585 (SLAC-PUB—4428) Experimental results on QCD [Quantum Chromodynamics] from e^+e^- annihilation. de Boer, W. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik; Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1987. Contract AC03-76SF00515. 25p. (CONF-8705241—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004378/JAW.

From 10. WARSAW symposium on elementary particle physics; Kazimierz, Poland (25 May 1987).

A review is given on QCD results from studying e^+e^- annihilation with the PEP and PETRA storage rings with special emphasis on jet physics and the determination of the strong coupling constant α/sub s/. 92 refs., 28 figs., 3 tabs.

16586 (SLAC-PUB—4468) New results on the tau lepton. Gan, K.K. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1987. Contract AC03-76SF00515. 14p. (CONF-870821—5). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004628/JAW.

From SLAC summer institute on particle physics; Stanford, CA, USA (10 Aug 1987).

This is a review of new results on the tau lepton. The results include precise measurements of the lifetime, measurements of the decay tau$^-$ $\rightarrow \pi^- 2\pi^0$nu/sub tau/ with much improved precision, and limits on decay modes containing eta mesons, including the second-class-current decay tau$^-$ $\rightarrow \pi^-$eta nu/sub tau/. The implications of these new results on the discrepancy in the one-charged-particle decay modes are discussed. 52 refs., 6 figs., 2 tabs.

16587 (SLAC-PUB—4481) The one charged particle decay modes of the tau. Perl, M.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1987. Contract AC03-76SF00515. 11p. (CONF-8709147—8). NTIS, PC A03. Order Number DE88004903/JAW.

From International symposium on the production and decay of heavy flavors; Stanford, CA, USA (1 Sep 1987).

Tables of measurements of the total branching fraction of tau lepton decays to modes with one charged particle are given along with the major individual branching fractions. The reason a combination of measurements and calculations is needed to display the discrepancy is described briefly. It is argued that uncertainties in measurements of the branching fractions for multiple photon decay modes prevent complete reliance on experiment. The multiple photon modes are discussed in more detail. Present research on experimental technique problems relative to the apparent discrepancy is summarized. (LEW)

16588 Precise measurement of the asymmetry parameter δ in muon decay. Balke, B.; Gidal, G.; Jodidio, A.; Shinsky, K.A.; Steiner, H.M.; Stoker, D.P.; Strovink, M.; Tripp, R.D.; Carr, J.; Gobbi, B. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] D: Particles and Fields;* **37**: No. 3, 587-617(1 Feb 1988). Contract AC03-76SF00098.

Highly polarized μ^+ from the surface muon beam at TRIUMF have been analyzed by means of the muon-spin-rotation technique to determine the parity-violating muon decay asymmetry as a function of the daughter positron's momentum. The primary result is a determination of the muon decay parameter δ to high precision [$\delta = 0.7486 \pm 0.0026(\text{stat}) \pm 0.0028(\text{sys})$] consistent with the prediction $\delta = 0.75$ of the standard model of weak interactions. The implications of this measurement for generalized four-fermion contact interaction models of muon decay are discussed. The data are also used to constrain the parameters in certain left-right-symmetric and supersymmetric extensions of the standard model, and to limit the existence of lepton-number-violating scalar decays of the muon [$\mu \rightarrow e\sigma$, where $m(\sigma) < 80$ MeV/c^2].

16589 Finding gluinos at hadron colliders. Barnett, R.M.; Gunion, J.F.; Haber, H.E. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **60**: No. 5, 401-404(1 Feb 1988). Contract AC03-76SF00098;AM03-76SF00010.

In the minimal supersymmetric model, we show that the branching ratio for a heavy gluino (M/sub g-italic-tilde/approx. >600 GeV) to decay directly into the lightest supersymmetric particle is less than 14%, independent of nearly all parameter assumptions. Thus, the traditional jets+E/sub T//sup miss/ signature is substantially reduced. We describe the results of a comprehensive survey of search strategies as a function of the supersymmetric parameter space, and identify those which are most promising. We

consider a range of gluino masses appropriate to both existing and future colliders.

16590 Measurements of R and a search for heavy-quark production in e^+e^- annihilation at $\sqrt{s}$ = 50 and 52 GeV. Sagawa, H.; Mori, T.; Abe, K.; Chakrabarti, S.; Fujii, Y.; Higashi, Y.; Ishimoto, S.; Kurihara, Y.; Maki, A.; Mani, P.; and others. (KEK National Laboratory for High Energy Physics, Ibaraki 305, Japan). *Physical Review Letters;* 60: No. 2, 93-96(11 Jan 1988).

The R ratio for e^+e^- annihilation into hadronic final states is measured to be 4.34 +- 0.45 +- 0.30 and 4.23 +- 0.20 +- 0.21 at c.m. energies of 50 and 52 GeV, respectively. From these values of R and an analysis of the event shapes we deduce a 95%-confidence-level upper limit for the production rate of new heavy charge +(2/3e or -(1/3e quarks to be 0.19 units of R.

16591 Reanalysis of charmed—D-meson branching fractions. Adler, J.; Becker, J.J.; Blaylock, G.T.; Bolton, T.; Brown, J.S.; Bunnell, K.O.; Burnett, T.H.; Cassell, R.E.; Coffman, D.; Cook, V. (California Institute of Technology, Pasadena, California 91125). *Physical Review Letters;* 60: No. 2, 89-92(11 Jan 1988).

We report a revised determination of charmed—D-meson absolute branching fractions based on complete reconstruction of DD-bar events at the psi(3770). Two backgrounds, Cabibbo-suppressed and multi-π^0D decays, are addressed in detail. The first measurement of the decay $D^0 \to K^-\pi^+\pi^0\pi^0$ establishes the sensitivity to hitherto unobserved multi-π^0 modes. Removal of both backgrounds reduces the values of our previously reported branching fractions by (21—24)% leaving their ratios largely unchanged. The new values are unable to account fully for a reported deficit in charm production in B-meson decay.

16592 Production of four-prong final states in photon-photon collisions. Aihara, H.; Alston-Garnjost, M.; Avery, R.E.; Barbaro-Galtieri, A.; Barker, A.R.; Barnes, A.V.; Barnett, B.A.; Bauer, D.A.; Bengtsson, H.; Bintinger, D.L.; and others. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 1, 28-40(1 Jan 1988).

Results are presented on the exclusive production of four-prong final states in photon-photon collisions from the TPC/Two-Gamma detector at the SLAC e^+e^- storage ring PEP. Measurement of dE/dx and momentum in the time-projection chamber (TPC) provides identification of the final states $2\pi^+2\pi^-$, $K^+K^-\pi^+\pi^-$, and $2K^+2K^-$. For two quasireal incident photons, both the $2\pi^+2\pi^-$ and $K^+K^-\pi^+\pi^-$ cross sections show a steep rise from threshold to a peak value, followed by a decrease at higher mass. Cross sections for the production of the final states rho^{0}rho^0, rho$^0\pi^+\pi^-$, and phi$\pi^+\pi^-$ are presented, together with upper limits for phirho^0, phiphi, and K/sup */^{0}K-bar /sup */^{0}. The rho^{0}rho^0 contribution dominates the four-pion cross section at low masses, but falls to nearly zero above 2 GeV. Such behavior is inconsistent with expectations from vector dominance but can be accommodated by four-quark resonance models or by t-channel factorization. Angular distributions for the part of the data dominated by rho^{0}rho^0 final states are consistent with the production of J/sup P/ = 2^+ or 0^+ resonances but also with isotropic (nonresonant) production. When one of the virtual photons has mass (m/sub γ/^{2} = -Q^2not =0), the four-pion cross section is still dominated by rho^{0}rho^0 at low final-state masses W/sub $\gamma\gamma$/sub γ/ and by $2\pi^+2\pi^-$ at higher mass. Further, the dependence of the cross section on Q^2 becomes increasingly flat as W/sub $\gamma\gamma$/sub γ/ increases.

16593 Multihadronic events at E/sub c.m./ = 29 GeV and predictions of QCD models from E/sub c.m./ = 29 GeV to E/sub c.m./ = 93 GeV. Petersen, A.; Abrams, G.; Adolphsen, C.E.; Akerlof, C.; Alexander, J.P.; Alvarez, M.; Amidei, D.; Baden, A.R.; Ballam, J.; Barish, B.C. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 1, 1-27(1 Jan 1988). Contract AC03-81ER40050.

Multihadronic e^+e^- annihilation events at a center-of-mass energy of 29 GeV have been studied with both the original (PEP 5) Mark II and the upgraded Mark II detectors. Detector-corrected distributions from global shape analyses such as aplanarity, Q_3-Q_1, sphericity, thrust, minor value, oblateness, and jet masses, and inclusive charged-particle distributions including x, rapidity, p/sub perpendicular/, and particle flow are presented. These distributions are compared with predictions from various multihadron event models which use leading-logarithmic shower evolution or QCD matrix elements at the parton level and string or cluster fragmentation for hadronization. The new generation of parton-shower models gives, on the average, a better description of the data than the previous parton-shower models. The energy behavior of these models is compared to existing e^+e^- data. The predictions of the models at a center-of-mass energy of 93 GeV, roughly the expected mass of the Z^0, are also presented.

16594 Measurement of the average lifetime of hadrons containing bottom quarks. Klem; Atwood, W.B.; Barish, B.C.; Bonneaud, G.R.; Courau, A.; Donaldson, G.J.; Dubois, R.; Duro, M.M.; Elsen, E.E.; Gao, S.G.; and others. (California Institute of Technology, Pasadena, California 91125). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 1, 41-51(1 Jan 1988).

A measurement of the average lifetime of hadrons containing bottom quarks is presented. The b hadrons are produced in e^+e^- annihilation at 29 GeV, and the lifetime is determined from the impact parameters of high-transverse-momentum electrons produced in the decay of the b hadrons. A b lifetime of tau/sub b/ = 1.17/sup +0.27//sub -0.22/(stat)/sup +0.17//sub 0.16/(sys) psec is determined from a maximum-likelihood fit to the impact parameters. Particular care has been taken to describe the experimental resolution correctly in the fit.

16595 Differential cross section and analyzing power measurements for p+p elastic scattering at 497.5 MeV. Hoffmann, G.W.; Barlett, M.L.; Fergerson, R.W.; Marshall, J.A.; McGill, J.A.; Milner, E.C.; Ray, L.; Amann, J.F. (Department of Physics, The University of Texas at Austin, Austin, Texas 78712). *Physical Review* [*Section*] *C: Nuclear Physics;* 37: No. 1, 397-400(Jan 1988).

Differential cross sections for proton-plus-proton elastic scattering at 497.5 +- 0.5 MeV are reported for the center-of-momentum angular range $6^0 \leqq \theta$/sub c.m./$\leqq 97^0$. Statistical and relative point-to-point errors are typically $\leqq$ +- 1% and $\leqq$ +- 2%, respectively. Elastic analyzing powers over the range $16^0 \leqq \theta$/sub c.m./$\leqq 97^0$ are also reported. Typical statistical and relative point-to-point uncertainties are +- (0.01—0.03) and +- 1%, respectively. Absolute normalization of both the $d\sigma/d\Omega$ and A/sub y/ data is obtained through comparison with absolute data from other experiments. Absolute normalization uncertainties are +- 2% (cross section) and +- 1% (analyzing power). The data are compared with existing data near 500 MeV and with predictions of solutions from phase shift analysis.

16596 Search for short-lived neutral particles emitted in K^+ decay. Baker, N.J.; Gordon, H.A.; Lazarus, D.M.; Polychronakos, V.A.; Rehak, P.; Tannenbaum, M.J.; Egger, J.; Herold, W.D.; Kaspar, H.; Chaloupka, V. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* 59: No. 25, 2832-2835(21 Dec 1987). Contract AC02-76CH00016.

We have searched for the decay process $K^+ \to \pi^+ A^0$, where A^0 is any particle of mass less than 100 MeV/c^2 decaying into e^+e^-. Upper limits for the branching ratio are given as a function of mass and lifetime of the A^0. For lifetimes shorter than 10/sup -13/ sec, a limit of 4.5 x 10/sup -7/ at the 90% confidence level is obtained.

16597 **CP invariance in the reaction anti pp -> anti ΛΛ -> anti pπ/sup +/pπ/sup -/ at 1.546 GeV/c.** Barnes, P.D.; Diebold, G.; Franklin, G.; Hertzog, D.; Maher, C.; Quinn, B.; Seydoux, J.; Szymanski, J.; Birien, P.; Bonner, B.E. (Carnegie-Mellon Univ., Pittsburgh, PA, USA; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France. Dept. de Physique Nucleaire; Los Alamos National Lab., NM, USA). *Physics Letters [Section] B;* **199**: No. 1, 147-150(10 Dec 1987).

In a study of hyperon production with antiprotons at the CERN Low-Energy Antiproton Ring (LEAR), we have measured the ratio A = (α+α)/(α-α). Here α and α are the decay asymmetry parameters of the Λ and Λ non-leptonic charged decays. The hyperons were produced with identical polarization in the reaction anti pp -> ΛΛ at an incident anti p momentum of 1.546 GeV/c. The results, A = -0.07+-0.09, is consistent with zero, as required from CP invariance.

16598 **Measurement of the tau-lepton lifetime.** Abachi, S.; Akerlof, C.; Baringer, P.; Blockus, D.; Brabson, B.; Brom, J.H.; Bylsma, B.G.; Chapman, J.; Cork, B.; DeBonte, R. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **59**: No. 22, 2519-2522(30 Nov 1987). Contract W-31-109-ENG-38.

We report a new and precise measurement of the lifetime of the tau lepton. The data were taken with the High Resolution Spectrometer at the SLAC e^+e^- colliding-beam facility PEP operating at 29 GeV center-of-mass energy. The flight distances of 1311 tau decays to three charged particles were measured with a four-layer tubular-cell vertex chamber in conjunction with the main drift chamber. The resulting lifetime of the tau lepton is tau/sub tau/ (2.99 +- 0.15 +- 0.10) x 10/sup -13/ sec.

16599 **Experimental comments on the suppression of strangeness and diquarks in parton fragmentation.** Geist, W.M. (Lawrence Berkeley Lab., CA, USA). *Physics Letters [Section] B;* **196**: No. 2, 251-254(1 Oct 1987). Contract AC03-76SF00098.

Data on production of kaons and antiprotons from e/sup +/ e/sup -/ annihilation, deep-inelastic lepton-hadron, and hadron-hadron scattering are compared on a qualitative level. Evidence for unfamiliar trends is found.

16600 **Cosmic-ray depth studies at the homestate mine with $^{39}K \rightarrow ^{37}Ar$ detectors.** Fireman, E.L.; Cleveland, B.T.; Davis R. Jr.; Rowley, J.K. (Smithsonian Astrophysical Observatory). *AIP (American Institute of Physics) Conference Proceedings;* **126**: No. 1, 22-31(25 Jan 1985). (CONF-8408132—).

From Conference on solar neutrinos and neutrino astronomy; Lead, SD, USA (23 Aug 1984).

The argon-37 production rates in potassium detectors are measured at depths down to 4850 ft (4000 m.w.e.), the location of the chlorine solar neutrino detector in the Homestake Mine. The depth variation of the ^{37}Ar production rates in K agrees with that expected from cosmic ray muon interactions. At shallow depths, the ^{37}Ar production rates in K parallel those in Cl, with the ^{37}Ar rate per ton K equal to the ^{37}Ar rate per 615 tons of C_2Cl_4. At 4850 ft depth, the measurements give 0.07 +- 0.07 ^{37}Ar day^{-1} per ton of K, which is to be compared to the value of 0.46 +- 0.04 ^{37}Ar day^{-1} per 615 tons of C_2Cl_4 in the solar neutrino detector. The production in chlorine at 4850 ft depth; however, the error in the K measurements at 4850 ft depth is presently too large to determine accurately the cosmic ray background of the solar neutrino experiment. This error will be reduced by additional measurements.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 15702, 16316, 16356, 16360, 16578, 16593, 16700, 16713, 16713, 16730, 16748, 16752, 16976, 16980, 16997, 17012, 17076, 17080, 17080, 17121

16601 **(BNL—40447) Multiparticle production in deep inelastic lepton scattering and soft proton proton collisions.** Werner, K. (Brookhaven National Lab., Upton, NY (USA)). Jun 1987. Contract AC02-76CH00016. 22p. (CONF-8706198—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003490/JAW.

From 27. Cracow school of theoretical physics: structure of fundamental interactions; Zakopane, Poland (3 Jun 1987).

We demonstrate how the theoretical knowledge about multiparticle production in deep inelastic lepton scattering can be incorporated into a multistring model for low p/sub t/ proton proton collisions. 25 refs., 8 figs.

16602 **(BNL—40549) Multiple collision effects on the antiproton production by high energy proton (100 GeV - 1000 GeV).** Takahashi, Hiroshi; Powell, J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 21p. (CONF-8710125—11). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004873/JAW.

From 2. review and planning workshop on antiproton science and technology; Santa Monica, CA, USA (6 Oct 1987).

Antiproton production rates which take into account multiple collision are calculated using a simple model. Methods to reduce capture of the produced antiprotons by the target are discussed, including geometry of target and the use of a high intensity laser. Antiproton production increases substantially above 150 GeV proton incident energy. The yield increases almost linearly with incident energy, alleviating space charge problems in the high current accelerator that produces large amounts of antiprotons.

16603 **(BNL—40556) Particle production at SSC.** Paige, F.E.; Ranft, J.; Stanev, T.; Wang, E.M. (Brookhaven National Lab., Upton, NY (USA); Lawrence Berkeley Lab., CA (USA); Bartol Research Foundation of the Franklin Inst., Newark, DE (USA)). Nov 1987. Contract AC02-76CH00016. 6p. (CONF-8711138—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004877/JAW.

From SSC workshop on radiation damage; Berkeley, CA, USA (9 Nov 1987).

It is estimated that at 40TeV the total cross section is σ/sub tot/ ≃ 130mb, the average charged multiplicity is n/sub ch/ ≃ 110, and the height of the rapidity plateau is dn/sub ch//dy ≃ 6 for small y. Deviations of more than 50% from these values seem quite unlikely. 14 refs.

16604 **(BNL—40557) Soft and hard scattering at SSC.** Paige, F.E. (Brookhaven National Lab., Upton, NY (USA)). Nov 1987. Contract AC02-76CH00016. 11p. (CONF-8711138—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005030/JAW.

From SSC workshop on radiation damage; Berkeley, CA, USA (9 Nov 1987).

The interplay between soft and semi-hard scattering at SSC energies is discussed. It is argued that hard scattering has a negligible effect on the total cross section, although it does affect the multiplicity.

16605 **(CBPF-MO—002/87) Lectures on weak interactions: from Fermi-Majorana-Perrin to Glasgow-Weinberg-Salam and some contributions from Latin American physicists.** Lopes, J.L. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 65p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700137/JAW.

Historical aspects on the development of the physics of weak interactions which, after about forty years, converged with quantum electrodynamics to give birth ot the first model of unification of interactions, the so-called electroweak standard model, are presented.

16606 (CBPF-NF—016/87) New scheme for nonleptonic decays: predictions over the F^+ meson. Bediaga, I.; Predazzi, E.; Tiomno, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700141/JAW.

A new dynamical scheme of hadronization for nonleptonic decays is proposed. As testable consequences, new predictions over the F^+ lifetime, over the branching ratio BR(F^+ ->lvx) and over the decay F^+->PI^+ PI/sup o/ (implying violation of the $\Delta I=1$ rule) are given.

16607 (CBPF-NF—017/87) New hadronization scheme: the case of explicit charm decay. Basdevant, J.L.; Bediaga, I.; Predazzi, E.; Tiomno, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700142/JAW.

A model proposed recently for explaining the decay of pseudoscalar charmed mesons is apllied to studying their explicit decay into two pseudoscalar mesons. The model realizes quark confinement and asymptotic freedom in a simple minded way which leads in a natural way to the enhacement of the hitherto neglected W-exchange and W-annihilation decay modes. The key ingredient giving rise to this enhancement is the appearance of a new term violating the vector (as well as the axial-vector) current conservation in addition to the usual one proportional to the differences (sums) of quark masses which are negligibly small. In the valence quark approximation these new contributions are estimated and found to be in quite good agreement with all available data. Many predictions are made which could and should be experimentally checked.

16608 (CEA-CONF—9013) Hadron spectroscopy on the lattice. Lacaze, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Mar 1987. 8p. (CEA-SPh-T—87-079; CONF-870390—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751536/JAW.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

In this short review on numerical simulations of hadron spectrum (π, rho, N, Δ), the emphasis is put on the continuum limit and on the difficulty to reach the physical points.

16609 (CEA-CONF—9017) Q.C.D. and the rise of two minijet inclusive cross section. Mueller, A.H.; Navalet, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Mar 1987. 8p. (CONF-870390—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751538/JAW.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

An inclusive two-minijet cross section is described. The energy dependence of the cross section is calculated within perturbative QCD and related to a bare Pomeron in QCD in the region where a leading logarithmic expansion is valid. A rise as fact as S/ sup 1/2/ is predicted between ISR and SppS energies.

16610 (CEA-CONF—9023) Spin observables in hyperon production. Bertini, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie). Apr 1987. 13p. (CEA-DPH-N-S—2451; CONF-8703225—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751338/JAW.

From European hadron facility workshop; Friburg, F.R. Germany (30 Mar 1987).

A large amount of data collected in the last decade on inclusive hyperon production shows striking regularities that have so for eluded a satisfactory explanation. Current theory and experimental observations are discussed and reviewed in view of a future experiment at Saturne.

16611 (CONF-8708210—1) Color magnetism in pion photoproduction and radiative delta decay. Mukhopadhyay, N.C.; Davidson, R. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Physics). 1987. Contract AC02-83ER40114. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002144/JAW.

From 2. international workshop on pi-N interaction; Los Alamos, NM, USA (1 Aug 1987).

We use the extant multipole data base to extract the γN-Δ transition amplitudes, using the phenomenology of the effective Lagrangian approach. We find evidence for hadronic color magnetism in the radiative delta decay amplitudes. 24 refs., 2 tabs.

16612 (DOE/ER/10587—T4) Theoretical high energy physics research at the University of Chicago: Progress report, April 1, 1987-March 31, 1988. Rosner, J.L.; Sachs, R.G. (Chicago Univ., IL (USA)). Dec 1987. Contract AC02-80ER10587. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004534/JAW.

This paper briefly discusses the high energy physics work done at the University of Chicago. Certain topics discussed are: hadron spectroscopy, CP violation, neutral leptons, supersymmetry, magnetic moments of baryons and quarks, low energy effective field theories, electromagnetic properties of baryons and mass mixing of quarks and neutrinos. (LSP)

16613 (DOE/ER/40048—42-N7) Construction of six-quark states from parity eigenfunctions for n-n processes. Stancu, F.; Wilets, L. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory; Liege Univ. (Belgium). Inst. de Physique). 1987. Contract AC06-81ER40048. 6p. (CONF-8707144—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004168/JAW.

From Workshop on quarks in hadrons and nuclei; Erice, Italy (16 Jul 1987).

The work presented is to classify and construct six-quark states as totally antisymmetric states of six fermions, each described by orbital, spin, isospin, and color degrees of freedom. A classification scheme is proposed based on parity eigenfunctions. The single-particle hamiltonian is assumed to be reflectionally and axially symmetric and can be obtained, for example, from constrained Hartree-Fock or solition mean field theories. The ultimate aim is to study N-N processes in the context of the (relativistic) soliton bag model. (LEW)

16614 (DOE/ER/40048—47-N7) Quark model calculation of p anti p → Λ anti Λ. Alberg, M.A.; Braeuer, K.; Henley, E.M.; Wilets, L. (Seattle Univ., WA (USA); Washington Univ., Seattle (USA)). 1987. Contract AC06-81ER40048. 5p. (CONF-8709160—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004229/JAW.

From 4. LEAR workshop; Villars-sur-Ollon, Switzerland (6 Sep 1987).

A number of quark models for describing the annihilation of nucleons and antinucleons into mesons and strange baryons have been described in the literature. Chief among them are the one gluon exchange model (sometimes called $^3S_1$) and the $^3P_0$ model. An alternate model, which incorporates features of both of these models, is used to calculate p anti p → Λ anti Λ, presented here in Born approximation. 8 refs., 3 figs.

16615 (DOE/ER/40224—23) Rare decays of B mesons. Deshpande, N.G. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). 1986. Contract FG06-85ER40224. 7p. (CONF-860168—7; OITS—321). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003524/JAW.

From Workshop on observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities; Los Angeles, CA, USA (15 Jan 1986).

In future accelerators it is likely that B meson production would be copius, permitting measurements of branching ratios to a level of 10^{-7} or so. We discuss several rare decays that would permit testing electroweak theory at one loop. Some also involve CP violating asymmetries.

16616 (DOE/ER/40224—37) Rare B decays at the SSC: Standard and nonstandard modes and prospects for CP violation. Deshpande, N.G.; Soni, A. (Oregon Univ., Eugene (USA); California Univ., Los Angeles (USA)). Oct 1986. Contract FG06-85ER40224. 6p. (CONF-8606215—47; OITS—342; UCLA—86/TEP/39-10/86). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004159/JAW.

From Summer study on the physics of the superconducting super collider; Snowmass, CO, USA (23 Jun 1986).

Rare decays of B mesons are discussed. We deal with some of the interesting modes that are allowed by the standard model and proceed via a photon or gluon induced penguin graphs and some that proceed via tree or box graphs. We also discuss some non-standard modes, i.e., those that occur in horizontal gauge models and give rise to lepton number violating, mixed lepton flavor final states. Regarding CP on-conservation we focus primarily on two body exclusive modes which typically have branching ratios of order 10^{-5}. Many of the modes may have fairly large CP asymmetries. We examine the mode $B \rightarrow K\pi$ at some length. The mode is interesting for its simplicity (which may help in reconstruction of the B), but also perhaps more importantly, with proper K, π separation and charge identification there is no need for tagging decay products of both B and $^{-}$B. The question of CP non-conservation can be examined (for both charged and neutral B's) by detecting only a single ($K\pi$) pair. The calculations for the rate and the asymmetry are, at present, rather unreliable. It is extremely important to search for these and other modes with sensitivities of 10^{-6} (i.e., prior to SSC) or better, as they will provide important constraints on the relevant calculations and thereby also help in a reliable selection of decay mode(s) for CP searches. The latter are likely to require sensitivities of 10^{-7} or better.

16617 (DOE/ER/40224—39) Production and detection at SSC of Higgs bosons in left-right symmetric theories. Gunion, J.; Kayser, B.; Mohapatra, R.N.; Deshpande, N.G.; Grifols, J.; Mendez, A.; Olness, F.; Pal, P.B. (California Univ., Davis (USA). Dept. of Physics; National Science Foundation, Washington, DC (USA). Div. of Physics; Maryland Univ., College Park (USA). Dept. of Physics; Oregon Univ., Eugene (USA). Inst. of Theoretical Science; Barcelona Univ. (Spain). Dept. de Fisica Teorica; Illinois Inst. of Tech., Chicago (USA). Dept. of Physics). Dec 1986. Contract FG06-85ER40224. 14p. (OITS—345). NTIS, PC A03. Order Number DE88004160/JAW.

We discuss the production and detection at SSC of charged and neutral Higgs bosons of the left-right symmetric theories. The H^{+}, which is largely a member of a left-right "bidoublet," should be detectable. The H_0', a more unusual Higgs particle which, apart from mixing, is in a right-handed triplet and does not couple to quarks, may be detectable too.

16618 (DOE/ER/40224—40) Branching, geometrical scaling, and KNO scaling. Chen, W.R.; Hwa, R.C. (Oregon Univ., Eugene (USA)). Dec 1986. Contract FG06-85ER40224. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004108/JAW.

The phenomenon of KNO scaling up to about 100 GeV in cm energy in pp collision is described in a branching model supplemented by impact-parameter smearing with geometrical scaling as an essential input. High-accuracy fit of all data points from CERN-ISR is achieved by use of only one parameter which relates the particle productivity to hadron opacity at each impact parameter. It is deduced that the average number of initial clusters is between 4 and 5, depending upon the energy. 21 refs., 3 figs.

16619 (DOE/ER/40224—41) Higher-order corrections to multiplicities. Tesima, K. (California Univ., Davis (USA). Dept. of Physics; Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Jan 1987. Contract FG06-85ER40224. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004109/JAW.

A simplified integral equation for the multiplicity distribution of hadrons in jets is introduced as a systematic and practical method. The energy dependence of the averaged multiplicity is calculated by the method in the next-to-leading order. The result is different from that obtained by Mueller. The multiplicity ratio r = <n>/sub F^{3}//<n>/sub $e^{+}e^{-}$ is also calculated in the next-to-leading order. 12 refs., 7 figs.

16620 (DOE/ER/40224—47) A higher twist correction to heavy quark production. Brodsky, S.J.; Gunion, J.F.; Soper, D.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); California Univ., Davis (USA). Dept. of Physics; Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Jun 1987. Contract FG06-85ER40224. 7p. (CONF-870339—6; OITS—359). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004547/JAW.

From Moriond meeting on hadrons, quarks and gluons; Les Arcs, France (15 Mar 1987).

The leading twist prediction for heavy quark production and a model for a higher twist correction that may be important for charm production was discussed. The correction arises from the interaction of the charm quark with spectator quarks.

16621 (DOE/ER/40224—50) Detection of a new Z' in the $Z' \rightarrow W^{+}W^{-}$ mode at the SSC. Deshpande, N.G.; Gunion, J.F.; Zwirner, F. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science; California Univ., Davis (USA). Dept. of Physics; Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AS03-80ER70191;AC03-76SF00098;FG06-85ER40224. 8p. (LBL—23744; OITS—363; UCD—87-18; CONF-870739—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004809/JAW.

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

If a new Z' exists with mass in the TeV region, the decay rate for the mode $Z' \rightarrow W^{+}W^{-}$ is expected to be of the same order as the ones for $Z' \rightarrow e^{+}e^{-}$ or $Z' \rightarrow \mu^{+}\mu^{-}$. This mode can be detectable at the SSC via the secondary decays WW $\rightarrow$ (jet jet)(l nu), (l = e,μ). We compare the expected signal with the backgrounds coming from continuum WW production and W jet jet production in the standard model. Using for this decay selection criteria analogous to the ones proposed for the corresponding decay of a heavy Higgs, we conclude that the signal/background ratio should be considerably larger in the Z' case. This is primarily because, for masses in the TeV range, the Z' width is very much smaller than the Higgs width.

16622 (EFI—866(17)-86) Associated multiplicity of γ-particles in processes of lepton pair production on nuclei. Gevorkyan, S.R.; Gulkanyan, H.R.; Vartanyan, V.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700145/JAW.

An expression has been obtained for mean multiplicity of g-particles accompanying the process of deep-inelastic lepton pair production on nuclei. The expression allows one to get information on structure peculiarities of leading hadron in this process. 4 references, 2 figures.

16623 (EFI—868(19)-86) $E^{+}e^{-}$ -> q-barqg process cross section transverse momentum distribution for heavy quarks. Shakhnazaryan, Yu.G. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700146/JAW.

In QCD framework the influence of taking the mass of heavy quarks into account on the distribution over the value T (thrust, the momentum of the most energetic parton) and on transverse to T-vector axis momentum x/sub perpendicular/ of each of two other partons in the process $e^{+}e^{-}$ -> qq-barg, responsible for three-jet events in $e^{+}e^{-}$ annihilation, is investigated. It is shown that the account of quark mass has a considerable effect on theory predictions. This leads to significant expansion of variation range of x/sub perpendicular/ as compared with the massless case, to the shift of this range towards small values of x/sub perpendicular/ and also to structures in curves describing the dependence of the cross section $d^{3}\sigma$/dTdx/sub perpendicular/ on x/sub perpendicular/. 8 references, 3 figures.

16624 **(EFI—870(21)-86) Angular distributions for three-jet process e^+e^- ->qq-barg for heavy quarks.** Shakhnazaryan, Yu.G. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700147/JAW.

On the basis of the most general expression for e^+e^- -> qq-barg process cross section calculated in the first order in α/sub s/ with regard to primary particles polarization and the mass of quark, the dependence of the cross section $d^3\sigma$/dTdT-vector on the polar and azimuthal angles of the vector T-vector (thrust) spatial orientation is found. Calculations carried out at some values of T show that the coefficients determining the angular dependence of the cross section considerably depend on the mass parameter eta. An analysis of angular distributions depending on the values of the parameters T and eta is made. 6 references, 3 figures.

16625 **(EFI—872(23)-86) Influence of color screening effect on interaction of high energy photons with nucleons and nuclei.** Gevorkyan, S.R.; Gulkanyan, G.R. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700149/JAW.

The color screening effect in hadronic component of photon is taken into account in total cross sections of interaction of high energy photons with nucleons and nuclei. 9 references, 1 figure.

16626 **(EFI—873(24)-86) Photo-and electroproduction of charmed particles on nuclei.** Gevorkyan, S.R.; Kotsinyan, A.M.; Zhamkochyan, V.M. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700150/JAW.

The processes of photo- and electroproduction of charmed hadrons h/sub c/ on nuclei are considered. The values of effective nucleon numbers are predicted in the framework of multiple scattering theory, using a two-step mechanism of h/sub c/ production. It is shown that in the presence of sufficiently exact experimental data one can estimate the cross section of c-quark-nucleon interaction. 6 references.

16627 **(EFI—899(50)-86) Multiparton recombination model and spectra of direct hadrons at high energies.** Badalyan, R.G.; Gulkanyan, G.R. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700162/JAW.

A brief description of multiparton recombination model of hadron production with small transverse momenta in the fragmentation regions of interacting hadrons is presented. It is shown that in this model the inclusive spectra of hadrons at a Feynman variable x — 1 are determined by the number of valence quarks N/sub V/ common for incident and final hadrons, and by parameter W, determining the probability of an incident hadron sea parton being included in the sea of the registered hadron, which W, in its turn, definitely depens on N/sub V/. Expressions are obtained for inclusive spectra of the direct production of mesons and baryons in the proton fragmentation region in nondiffraction processes. 4 references, 1 figure.

16628 **(EFI—900(51)-86) Quark-to-hadron fragmentation functions.** Badalyan, R.G. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700163/JAW.

A statistical approach to the question of fragmentation of quark-gluonic systems is considered. The functions of fragmentation of multiparton quark-gluonic system with quark quantum numbers to hadrons are defined. A comparison of the model predictions with experimental data is carried out with respect to π^+/π^--meson yields in deep-inelastic scattering of neutrino (antineutrino) on the nucleon. 14 references, 1 figure, 1 table.

16629 **(EFI—909(60)-86) Production of pseudoscalar boson in pp-bar and pp-collisions.** Grigoryan, S.G.; Chatrchyan, S.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700167/JAW.

The gluonic mechanism of pseudoscalar Higgs boson production is studied. It is shown that its production cross section for heavy quarks (2m/sub q/ > m/sub p/) is twice as high as that for scalar Higgs production. 1 reference, 1 figure.

16630 **(IFUSP-P—613) Looking for spin 3/2 leptons in hadronic collisions.** Spehler, D.; Eboli, O.J.P.; Marques, G.C.; Novaes, S.F.; Natale, A.A. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1986. 11p. (IFT-P—16/86). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700187/JAW.

Cross sections are computed for the production or spin 3/2 leptons in proton-proton collisions, under general assumptions on the coupling of these fermions with ordinay particles. If the compositeness scale is 1-5 TeV and for masses in the range 50-500 GeV these particles will be within the reach of Tevatron and SSC colliders. It is commented on possible signatures of such leptons.

16631 **(IFVE-OEF—86-21) Data analysis on high Pperpendicular hadron production in pA collisions at 70 GeV.** Abramov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700192/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

The data on high Pperpendicular hadron production in pA-collisions at 70 GeV have been analyzed. Experimental estimations of the hadron formation lengths and effective parton absorption cross sections have been obtained in the frames of the quark-parton model. 32 references, 6 figures.

16632 **(IFVE-OEIPK—86-91) Data analysis on lepton-proton deep inelastic scattering.** Alekhin, S.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700194/JAW.

Joint analysis of global set of the lepton-proton deep-inelastic scattering data on the basis of the leading order of perturbative QCD is performed. Parametrization of parton distributions in nucleon and parton luminosities (parton energy spectra) in the TeV-region free of nuclear effects are obtained. 23 references, 15 figures, 1 table.

16633 **(IFVE-OTF—85-176) Mechanism of rising cross sections in hadron-hadron collisions.** Gershtejn, S.S.; Logunov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700199/JAW.

The interaction of sea constituents with each other and valence quarks, occurring in high-energy hadron collisions, is shown to explain the experimentally observed law for the rise of total cross sections, as well as the energy value at which this rise starts and the difference in these energy values for πN, KN and NN(N-barN) reactions. 8 references.

16634 **(INIS-BR—869) Current algebra method for form factors and strong decays with hard pions and kaons.** Srivastava, P.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1969. 72p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700203/JAW.

The F/sub K//F/sub PI/ ratio between the kaon and pion decay couplings in one lepton pair, sum rules for Weinberg spectral functions, form factor renormalization of the K/sub l3/ decay because of the SU(3) symmetry violation and the calculations of strong decays of the K* and K /sub A/ strange resonances are presented and discussed.

16635 **(INIS-mf—10777) S-wave scattering of nucleon and antinucleon in the non-relativistic quark model.** Ihle, G. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1986. 128p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751508/JAW.

In the framework of the constituent quark model s-wave nucleon-antinucleon scattering via quark rearrangement into three-meson states is calculated. With a Hamiltonian containing only the kinetic energy of the involved six quarks and a two body confining interaction coupled equations for the nucleon-antinucleon and the three-meson states are derived. The intercluster wave-functions of both reaction-channels are represented with generator coordinates. One eliminates the intermediate meson states and obtains a SU(4)-invariant energy-dependent optical potential which is effective in Nanti N s-wave only. In order to compare the model to recent LEAR measurements of panti p scattering a long-range meson exchange has to be added to the quark mediated annihilation potential. In this way about half of the s-wave annihilation cross-section can be assigned to quark rearrangement. The results are, however, sensitive to the matching of the meson exchange potential with the microscopic rearrangement potential.

16636 (INIS-SU—427, pp 4-9) **On the decays tau -> 3μ and tau -> 3μ2ν.** Mzhaviya, D.A.; Mitsel'makher, G.V. (Tbilisskij Gosudarstvennyj Univ., USSR; Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Nuclear Problems). 1986. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780043/JAW. (JINR-N—20-86).

In JINR rapid communications. Collection.

Search for the decay r -> 3μ in beam-dump experiments at high-energy accelerators with a fixed target is shown to be possible at the 10/sup -7/-10/sup -9/ relative probability level. The probability of the background process r -> 3μ2ν is calculated. 12 refs.; 2 figs.

16637 (INIS-SU—427, pp 10-15) **Low-energy theorems of broken scale invariance for light scalar mesons.** Lanik, J. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Theoretical Physics). 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780043/JAW. (JINR-N—20-86).

In JINR rapid communications. Collection.

Low-energy theorems of broken scale invariance are discussed from the point of view of 1/N/sub c/ expansion. A simple effective Lagrangian model realizing these theorems and predicting scalar gluonium as well as quarkonium masses is presented. 11 refs.

16638 (INIS-SU—428, pp 17-25) **Hadron jets in deep inelastic ν-bar N interactions and universality of the jet properties in relative four-velocity space.** Baldin, A.M.; Didenko, L.A.; Grishin, V.G.; Kuznetsov, A.A.; Maneva, G.M.; Temnikov, P.P.; Metreveli, Z.V. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of High Energy; Tbilisskij Gosudarstvennyj Univ., USSR). 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780044/JAW. (JINR-N—1[21]-87).

In JINR rapid communications. Collection.

A new definition of the jets as clusters in the four-velocity space has been used to make an invariant analysis of the jet production processes in ν-barN collisions for the three energy intervals of the hadron system: W=3.5; 4.9; 8.0 GeV. The obtained results are compared with the characteristics of the four-dimensional jets in various types of interactions: pp, p-barp, π/sup -/p, π/sup -/C, pC and pTa at energies from 6 to 205 GeV. The characteristics of the four-dimensional jets in soft and hard interactions are shown to be universal, i.e., independent of neither the type of the fragmenting system (p, p-bar, π/sup -/, C, q), nor the collision energy for P/sub lab/ ≧ 22 GeV/c (√S=W > 6 GeV). The obtained result means that the hadronization of the colour charges is determined by the dynamics of their interaction with vacuum. 6 refs.; 3 figs.; 2 tabs.

16639 (INIS-SU—428, pp 34-39) **Quantum chromodynamic investigation of the pion electroproduction on the nucleon and the nucleon structure functions.** Sadykhov, F.S. (Azerbajdzhanskij Gosudarstvennyj Univ., Baku, USSR; Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Theoretical Physics). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780044/JAW. (JINR-N—1[21]-87).

In JINR rapid communications. Collection.

The deep inelastic scattering process of the charged lepton on the nucleon with the pion production and the nucleon structure functions in QCD with account of two- and three-gluon vertices are studied. 15 refs.; 4 figs.

16640 (INS—642) **Finite temperature renormalization group equation in QCD II.** Fujimoto, Yasushi; Yamada, Hirofumi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Aug 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751968/JAW.

An exact off-shell one-loop finite temperature calculation for massless QCD is carried out by the use of Thermo Field Dynamics. The result is used to predict the renormalization group improved effective coupling constant. The behavior of the coupling constant with respect to temperature and moment is found to differ depending on which vertex is chosen to define the coupling constant.

16641 (INS—643) **Mean field approximation to QCD, 1. Self-consistent equations of motion.** Tezuka, Hirokazu. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1987. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751969/JAW.

We apply mean field approximation to the gluon field in the equations of motion derived from the QCD lagrangian. The gluon mean field is restricted to the time-independent 0th component, and color exchange components are ignored. The equation of motion for the gluon mean field turns into a Poisson equation, and that for the quark field into a Dirac equation with a potential term. For example, assuming spherical symmetric box-like distribution and Gauss-like distribution to quarks, we try to solve these two equations simultaneously.

16642 (IPNO-TH—87-9) **γγ -> rhorho: an effective lagrangian approach.** Moussallam, B. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Feb 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751750/JAW.

The process γγ -> rhorho, at low energy, is considered using an effective lagrangian model. From the principle of vector dominance, it is related to the interactions of the rho meson with itself and with other low mass mesons. We find the pseudoscalar exchange terms to be rather small and the self-interaction one to be very important. Using a K-matrix parametrization of the amplitude, this contribution alone generates about one half of the rho/sup 0/ rho/sup 0/ cross-section. The amplitude for rho/sup +/rho/sup -/ then turns out to be much too large and has to be cancelled by other processes. We show that a diagram containing the tensor meson f plays this role in part. If the values of the coupling constants are taken from experiment, the cancellation is really effective only if a vertex form-factor is allowed for. Even so, the model is not sufficient to quantitatively explain the data.

16643 (IPNO-TH—87-12) **Attempt to extend the standard model to include invisible axions and majorons.** Kang, K.; Pantziris, A. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 10p. (BROWN/HET—605). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751625/JAW.

We present a modest extension of the standard model to include a Peccei-Quinn symmetry and a global lepton number symmetry both of which are spontaneously broken at the same invisible axion scale, thus eliminating the strong CP problem and generating masses for the light neutrinos that could explain the observed depletion of the solar neutrino flux. One consequence of our model is that the majoron becomes a pseudo-Goldstone boson that has extremely weak couplings to the matter, if the scalar singlet that breaks the lepton number symmetry carries nonzero P.Q. charge. The model has no apparent difficulties with known constraints.

16644 (IPNO-TH—87-32) **Introduction to axions.** Kang, K. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Apr 1987. 22p. (BROWN/HET—613; COO—3130-TA-388; CONF-8703136—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751751/JAW.

From Elementary structure of materials; Les Houches, France (24 Mar 1987).

This lecture is organized as following: after a brief discussion on the Nambu-Goldstone phenomena with pions as an example, I discuss the strong CP-problem and its resolution through the PQ mechanism in the standard model. Various predictions of the standard axion are compared to experiments to motivate the invention of an invisible axion. I then present the invisible axion model of Dine, Fischler and Srednicki and summarize the mass and coupling constants of the invisible axion from the consideration of astrophysical and cosmological constraints. In passing, I touch briefly upon the role of the invisible axion in the grand unification model building. Finally I present an electroweak gauge model that contains an invisible axion and Majoron which is motivated by the recent solutions to the solar neutrino problem in /sup 37/Cl -> /sup 37/Ar by the resonance amplification method of the oscillation in the matter.

16645 (ISN—87-04) Diquark structure of baryons. Silvestre-Brac, B. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Jan 1987. 25p. (CONF-8703177—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751628/JAW.

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Three body calculations for studying the baryons are performed in a non-relativistic treatment with three quarks interacting via Bhaduri's potential. From the resulting wave functions, it is analysed under which conditions can a diquark structure occurs. Several photos showing quark distributions inside the baryons are presented and discussed in details.

16646 (ISN—87-21) Y-N and λ-λ interaction. Dynamical calculations of the dilambda. Silvestre-Brac, B.; Carbonnel, J.; Gignoux, C. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Feb 1987. 12p. (CONF-8702101—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751629/JAW.

From Workshop on intermediate energies: short-range nuclear physics; Orsay, France (11 Feb 1987).

In the framework of the resonating group method, we calculate, with help of a non relativistic quark-quark potential due to Bhaduri, the phase shifts of the Y-N and λ-λ interactions in the pure SU(3) flavor limit. In the same model the binding energy of the dilambda is obtained and discussed.

16647 (ITEP—66(1985)) Second moments of quark and gluon distribution functions in hadrons. Belyaev, V.M.; Blok, B.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700254/JAW.

The second moments of quark and gluon distribution functions in nucleon and pion are calculated on the basis of the QCD sum rule method. The results obtained are in a good agreement with the experimental data. 11 references, 5 figures.

16648 (JINR-E—2-86-596) Analytic bremsstrahlung integration for the process $e^+e^- \to \mu^+\mu^-\gamma$ in QED. Fedorenko, O.M.; Riemann, T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700264/JAW.

Submitted to the journal Acta Physica Polonica.

The photon bremsstrahlung correction to the differential cross section and to the charge asymmetry of e^+e^- annihilation into two fermions has been integrated analytically over the complete photon phase space and is discussed in the framework of the electroweak standard theory. 14 references.

16649 (LAL—87-20) On the scalar electron mass limit from single photon experiments. Grivaz, J.F. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Mar 1987. 5p. (CONF-870390—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751754/JAW.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

We discuss how the 90% C.L. lower limit on the mass of the scalar electron, as extracted from the single photon experiments, is affected by the way the background from radiative neutrino pair production is handled. We argue that some of the results presented at the Berkeley conference are overoptimistic, and that the mass lower limit is 65 GeV rather than the advertized value of 84 GeV, for the case of degenerate scalar electrons with massless photinos.

16650 (LAL—87-27) Axions: a review. Davier, M. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). May 1987. 15p. (CONF-870390—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751414/JAW.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

The axion particle is the experimental consequence of a particular way to restore P conservation into the QCD theory. The standard axion phenomenology proceeds on a scale given by the electroweak symmetry breaking. Such an axion is ruled out experimentally. Recently, observation of monochromatic peaks in e/sup +-/ production in heavy-ion collisions at GSI Darmstadt has motivated some re-examination of the situation. There appears to be no way to save the notion of an axion at the electroweak scale. Furthermore, experiments with electron beam-dumps have proven, together with g-2 measurements that the GSI effect cannot be explained in terms of a fundamental particle coupled to the e/sup +/ e/sup -/ channel.

16651 (LBL—24039) Muon energy loss at high energy and implications for detector design. Eastman, J.J.; Loken, S.C. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 12p. (CONF-870739—11). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004568/JAW.

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

We study the effects of energy loss and associated electromagnetic showers on muon tracking and momentum measurement in muon detectors operating in the energy range 100 GeV-5 TeV. A detailed Monte Carlo simulation tracks muons and shower particles through a detector structure and evaluates the charged-particle environment in chambers. We find that catastrophic energy loss events accompanied by energetic showers can pose serious problems to designers of muon spectrometers. 14 refs., 6 figs.

16652 (RAL—85-038) On the $1/g^2$ corrections to hadron masses. Hoek, J.; Smit, J. (Rutherford Appleton Lab., Chilton (UK)). May 1985. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750909/JAW.

The strong coupling limit of lattice QCD is reviewed and the important corrections of order $1/g^2$ to the pion, rho, nucleon and delta masses are computed with Wilson's fermion method. The nucleon-delta mass difference is obtained by decomposing the baryon field into independent fields transforming in irreducible representations of the rotation-flavor group.

16653 (RAL—86-024) Breakdown of long-distance correlation method determination of the O^{++} glueball mass. Hoek, J. (Rutherford Appleton Lab., Chilton (UK)). Apr 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750910/JAW.

The O^{++} glueball mass on a 16^4 lattice in a β regime from 5.6 to 6.3 is determined, using the long-distance correlation method. The result is inconsistent with other calculations at lower β-values and one using another method in a comparable β-regime.

16654 (RAL—86-057) Quark and gluon fragmentation in high energy e^+e^- annihilation. Saxon, D.H. (Rutherford Appleton Lab., Chilton (UK)). Jul 1986. 62p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750845/JAW.

The paper on quark and gluon fragmentation in high energy e^+e^- annihilation is based on lectures given at the International School of High Energy Physics, Yugoslavia, 1986. Fragmentation Models, charged particle multiplicity, Bose-Einstein correlations, single particle inclusive distributions, hadrons in jets, leading particle effects, baryon production, comparison of quark and gluon jets, and the string effect, are all discussed.

16655 (RAL—86-072) Removing tachyons by compactification. Narain, K.S.; Sarmadi, M.H. (Rutherford Appleton Lab., Chilton (UK)). Jul 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750916/JAW.

It is shown that tachyons in the recently discovered ten-dimensional non-supersymmetric heterotic string models can be removed by compactifying on torii in presence of large Wilson lines.

16656 (RAL—86-083) Gluons in nuclei and pions. Close, F.E.; Roberts, R.G.; Ross, G.G. (Rutherford Appleton Lab., Chilton (UK)). Aug 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750852/JAW.

The possibility of connecting apparently different descriptions of quarks in nuclei has already been shown. The authors pursue the consequences of this 'duality' for flavour-singlet distributions. An interesting possibility is that nuclear pions may have unusual quark-gluon substructure. Indeed, pions in general could be relatively 'rich' in glue.

16657 (RAL—86-089) Topology in Su(3) lattice gauge theory. Hoek, J. (Rutherford Appleton Lab., Chilton (UK)). Oct 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750905/JAW.

The paper concerns the use of topology in SU(3) lattice gauge theory. The U(1) and lattice calculations, topological susceptibility, and topological charge from Monte Carlo sweeps, are all discussed. (U.K.).

16658 (RAL—87-006) E_6 signatures in atomic physics. Bordes, J. (Rutherford Appleton Lab., Chilton (UK)). Feb 1987. 18p. Rutherford Appleton Lab., Chilton (UK).

The effect of neutral massive gauge bosons in atoms is considered in the framework of models inspired by superstring theories with low energy group E_6. Significant deviations from the prediction of the standard model are found in non-spinless light atoms. In models with two massive neutral gauge bosons the deviations are particularly important in Hydrogen if the ratio between the physical boson masses is < or approx., 3.

16659 (RAL—87-009) Space dimensions from supersymmetry for the N=2 spinning string. A four dimensional model. Adda, A.D'; Lizzi, F. (Rutherford Appleton Lab., Chilton (UK)). Feb 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750974/JAW.

Following a view diametrically opposite to recent attempts to obtain the supersymmetric string by compactifying the bosonic string in a high number of dimensions, the authors reinterpret the N=2, d=2 spinning string as an N=1 d=4 model, without using compactification.

16660 (SAND—87-1295) Impulse response of a frequency-dependent delay. Stearns, S.D.; Elliott, G.R. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004793/JAW.

This report describes three approaches for determining the impulse response of a unit-gain, frequency-dependent delay system. The system is meant to be a model of the electromagnetic phase shift of a homogeneous ionosphere. The three approaches involve (1) numerical integration, (2) the inverse discrete Fourier transform, and (3) a continuous approximation. The report concludes with an example in which the impulse response is convolved with a source function to produce an output signal.

16661 (SAND—87-2950C) Coherent VUV source at 130 nm: Theory and modeling. Smith, A.V.; Hadley, G.R.; Alford, W.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880110—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003874/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

The goal of this research is to maximize conversion efficiency of sum-frequency mixing in an energy scalable system. The 130.2-nm generation via two-photon-resonant four-wave mixing in Hg vapor for unfocused light beams emphasizing an understanding of efficiency-limiting processes has been analyzed. Calculations, based on measurements of Hg dipole matrix elements, indicate that mixing efficiencies of 5 to 10% should be possible.

16662 (SLAC-PUB—4408) Probing the non-minimal Higgs sector at the SSC. Gunion, J.F.; Haber, H.E.; Komamiya, S.; Yamamoto, H.; Barbaro-Galtieri, A. (California Univ., Davis (USA). Dept. of Physics; California Univ., Santa Cruz (USA). Inst. for Particle Physics; Stanford Linear Accelerator Center, Menlo Park, CA (USA); California Univ., Los Angeles (USA). Dept. of Physics; Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00515;AS03-80ER70191. 14p. (CONF-870739—13; SCIPP—87/109; UCD—87-25). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004379/JAW.

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

Non-minimal Higgs sectors occur in the Standard Model with more than one Higgs doublet, as well as in theories that go beyond the Standard Model. In this report, we discuss how Higgs search strategies must be altered, with respect to the Standard Model approaches, in order to probe the non-minimal Higgs sectors at the SSC.

16663 (SLAC-PUB—4469) Rare B decays and CP violation. Gilman, F.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1987. Contract AC03-76SF00515. 13p. (CONF-8709147—7). NTIS, PC A03. Order Number DE88004904/JAW.

From International symposium on the production and decay of heavy flavors; Stanford, CA, USA (1 Sep 1987).

We review the physics motivation for studying rare B decays and the increasing possibility that cP violation can be experimentally observed in the B meson system. 29 refs., 3 figs.

16664 (SLAC-PUB—4487) Search for heavy quarks in e^+e^-. Hanson, G.G. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1987. Contract AC03-76SF00515. 14p. (CONF-8709147—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004389/JAW.

From International symposium on the production and decay of heavy flavors; Stanford, CA, USA (1 Sep 1987).

The Open Top Group of the Mark II Collaboration at the SLAC SLC has been studying how to find new heavy quarks, particularly the top quark, in decays of the Z^0. Recent evidence suggests that the top quark mass (M/sub t/) may be larger than half the mass of the Z^0 (M/sub Z/). The UA1 Collaboration has set the limit M/sub t/ $>$ 44 GeV/c^2 using a conservative calculation for $\sigma(p\,\bar{p} \rightarrow t\,\bar{t})$ and $>$ 56 GeV/c^2 using a "reasonable" calculation for this cross section. Similarly, they have set limits on the b' quark mass of 25 and 41 GeV/c^2. The ARGUS Collaboration has reported the observation at the Y(4s) of B/sub d/^{0} - anti B/sub d/^{0} mixing at the 20% level, which indicates M/sub t/ $\geq$ 50 to 120 GeV/c^2, unless there are more than three generations. The three experiments at TRISTAN - AMY, TOPAZ, and VENUS - have reported M/sub t/ $>$ 26 GeV/c^2, although that is not a problem for the SLC since we are sensitive to a top quark of mass as large as 46 GeV/c^2. The Mark II Open Top Group is still optimistic that top may be found at the SLC. In any case, the search methods we have developed are quite general and could be applied to searches for other heavy particles in SLC data. The work of the Group has been divided into three main topics: establishing a signal, measuring the mass and determining the identity. We will first discuss the

Monte Carlo models, cross sections and analysis procedures, followed by the specific work on these topics. 11 refs., 10 figs., 5 tabs.

16665 **(SLAC-PUB—4495) Non multa, sed multum: Future lessons from two-prong, two-body decays of beauty.** Bigi, I.I.; Stech, B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). Dec 1987. Contract AC03-76SF00515. 6p. (CONF-8711128—1). NTIS, PC A02. Order Number DE88004889/JAW.

From Workshop on high sensitivity beauty physics at Fermilab; Batavia, IL, USA (11 Nov 1987).

There are four two-body, two-prong decays modes of B mesons and two for beauty baryons and they are quite rare, i.e., their branching ratios are not expected to exceed the script O(10^{-4}) level. Yet a detailed study of their relative rates with a sensitivity level of 10^{-5} can yield unique and important information on strong interactions. If the evolution of these reactions in proper time can be traced then, under favorable conditions, one can analyze B^0 - anti B^0 mixing and CP invariance in a detailed way. 4 refs.

16666 **(UCRL—96499) Two-dimensional electron fluid computer calculations of nanosecond pulse, low pressure microwave air breakdown in a rectangular waveguide and their verification by experimental measurement.** Mayhall, D.J.; Yee, J.H.; Alvarez, R.A.; Byrne, D.P. (Lawrence Livermore National Lab., CA (USA); Kaman Sciences Corp., Colorado Springs, CO (USA)). 23 Oct 1987. Contract W-7405-ENG-48. 17p. (CONF-871093—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004407/JAW.

From 8. international workshop on laser interaction and related plasma phenomena; Monterey, CA, USA (27 Oct 1987).

To assess the feasibility of the propagation of intense microwaves through the atmosphere, we must understand their interaction with the atmospheric air molecules. When an intense electromagnetic pulse passes through a gaseous medium such as the atmosphere, a number of physical processes can occur. The most important of these is avalanche ionization, which occurs when initially present free electrons are accelerated by the wave electric field and cause ionizing collisions with air molecules. If not rapidly removed from the region, free electrons can then multiply exponentially and reach a density, at which they remove energy from the electromagnetic wave. This energy loss can be strong enough to absorb the trailing part of the pulse and thus severely limit the energy the wave can transmit. Electrons may be lost by the processes of attachment, recombination with air ions, and diffusion out of the wave region. For pulse lengths of 100 nanoseconds and less, the characteristic times for attachment, recombination and diffusion are too long to be important and therefore may be neglected. Except for a case of detector diode saturation, the 2-D numerical electron-fluid model for air breadkdown of the TE10 mode in the WR-284 waveguide agrees well with transmitted power measurements for pressures from 3.5 to 300 Torr. The peak values are within 20% and the integrated envelope energies are within 13%. The modeled and measured values do not agree as well at 0.8 Torr, where the peak values are within 39% and the transmitted envelope energies are within 49%.

16667 **Sphaleron strikes back: A response to objections to the sphaleron approximation.** Arnold, P.; McLerran, L. (Fermi National Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 4, 1020-1029(15 Feb 1988).

The issue of sphaleron-induced baryon decay and various paradoxes related to the instanton method of computation are addressed. By various examples we argue that there is no contradiction between the instanton estimates and sphaleron estimates, and argue that for electroweak theory these estimates correspond to different approximations for distinct phenomena. We also investigate numerically the nature of the classical decay of a sphaleron in the (1+1)-dimensional Abelian Higgs model.

16668 **Gauge model of generation nonuniversality revisited.** Ma, E.; Li, X.; Tuan, S.F. (Department of Physics, University of California, Riverside, California 92521). *Physical Review Letters;* **60**: No. 6, 495-498(8 Feb 1988).

Six years ago, a gauge model of generation nonuniversality was proposed in which the tau lifetime was predicted to be longer, and B^0-B-bar^0 mixing to be greater, than in the standard model. Since current experimental data appear to favor both of these interpretations, an updated and improved analysis is here presented. In particular, a plausible branching fraction of the order 10/sup -4/ is predicted for $b \to s l^+ l^-$, just below the present experimental limit and well above the standard-model expectation of 10/sup -6/.

16669 **Exclusive decays B→K/sup (//sup i//sup)/γ resulting from b→sγ.** Altomari, T. (Physics Department, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 3, 677-680(1 Feb 1988).

Recently it has been suggested that the quark transition b→sγ might have a large enhancement. We use the quark model to estimate the rates for exclusive decays B→K/sup (//sup i//sup)/γ that result from b→sγ. The K/sup (//sup i//sup)/ are various K-meson excited states. While the ground state K/sup */(0.892) accounts for only a small fraction of the inclusive b→sγ rate, we estimate that a substantial fraction (~37%) of b→sγ decays will result in K/sup (//sup i//sup)/ with m/sub K//sub <(//sub i//sub =/ <m/sub D<//sub */sub =/. .AE

16670 **Cross sections for single-tagged two-photon production of resonances.** Cahn, R.N. (Lawrence Berkeley Laboratory, University of California, Berkeley, California, 94720). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 3, 833-836(1 Feb 1988). Contract AC03-76SF00098.

Simple formulas are given for the production cross section of narrow resonances in single-tagged photon-photon collisions. Production of spin-zero and spin-one states is considered.

16671 **Kinematical aspects of nonleptonic multiparticle decays of heavy baryons.** Lee, S.h. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 3, 707-718(1 Feb 1988).

I derive formulas for analyzing in a model-independent way the nonleptonic multiparticle decays of spin-(1/2 baryons. Two- and three-body decays with up to two vector bosons in the final states are considered as special cases. All information contained in the polarizations of spinors and vector bosons is kept. These formulas may also be used to analyze polarized nucleon and meson scattering.

16672 **Invisible decays of Higgs bosons in supersymmetric models.** Griest, K.; Haber, H.E. (Santa Cruz Institute for Particle Physics, University of California, Santa Cruz, California 95064). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 3, 719-728(1 Feb 1988).

We point out that the dominant decay of the light scalar Higgs boson in a supersymmetric model may be into a pair of the lightest neutralinos (assumed to be the lightest supersymmetric particles), which would result in an invisible final state. Thus, in the search at the Stanford Linear Collider and the CERN collider LEP for a Higgs scalar produced in association with a real or virtual Z boson, it is important not to cut out events with significant missing energy recoiling against the Z.

16673 **Asymmetries of heavy leptons in E_6 theories at hadron colliders.** Godfrey, S.; Hewett, J.L.; Rizzo, T.G. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 3, 643-648(1 Feb 1988). Contract AC02-76CH00016.

We consider the possibility of using the forward-backward asymmetry A/sub F//sub B/ to distinguish between the production of fourth-generation (L) and exotic (E) leptons in hadronic collisions within the context of E_6 theories. The existence of a new Z' resonance expected in such models and its subsequent decay into lepton pairs provides increased statistics and therefore a means to overcome the W^+W^- background in searches for heavy leptons. We find that for some models of current interest, A/sub F//sub B/ allows the determination of the lepton-Z' couplings at the Super-

conducting Super Collider, but not the Fermilab Tevatron, clearly separating these two possibilities when the lepton masses are relatively light (<200—250 GeV).

16674 **Splitting of the P states in heavy quarkonium systems and the nature of the spin-dependent potential.** Dib, C.O.; Gilman, F.J.; Franzini, P.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 3, 735-739(1 Feb 1988). Contract AC03-76SF00515.

We consider the behavior of the splittings between the L = 1 states in heavy quarkonium systems. With standard assumptions, the ratio of mass splittings, R/sub chi/ = $(M_2-M_1)/(M_1-M_0)$ is shown to grow slowly as we go from the lowest P states to their radial excitations, a behavior which is in accord with other theoretical calculations and is consistent with experiment. This behavior is the opposite of what is expected from a naive argument which we present. We show why the naive argument fails and how the phenomenological division of the potential into components which correspond to the exchange of a Lorentz scalar and vector can be made so as to obtain other behaviors.

16675 **Stability of dimesons.** Carlson, J.; Heller, L.; Tjon, J.A. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 3, 744-753(1 Feb 1988).

Using only the known short-distance behavior of quantum chromodynamics it is possible to prove that, for sufficiently large quark mass m, and fixed antiquark mass, the dimeson (Q^2q-bar ^{2}) must be stable against strong decay into two mesons. The binding energy is (1/9mα/sub s/^{2}[1+O(m/sup -1/)]. We then study systems in which Q is c or b, using the many-body confining interaction that comes from a Born-Oppenheimer approximation to the MIT bag model. The calculations were performed using the Green's-function Monte Carlo method. The 1^+ isoscalar dimeson T(bbu-bard-bar) is bound by ~70 MeV with respect to two B mesons; it can only decay weakly, therefore. The calculations of the dimesons (ccq-bar q-bar′) and (bcq-bar q-bar ′) are more uncertain, but indicate that the latter may also be bound.

16676 **Supersymmetric majoron signatures and solar neutrino oscillations.** Santamaria, A.; Valle, J.W.F. (Departament de Fisica Teo-grave-accentrica, Universitat de Valencia, 46100 Burjassot, Valencia, Spain). *Physical Review Letters;* 60: No. 5, 397-400(1 Feb 1988).

Spontaneous R-parity breaking in supergravity solves the solar neutrino problem through matter-enhanced neutrino oscillations. The model may be tested in collider experiments and through "dynamical" effects associated with the existence of a weakly interacting majoron. Apart from astrophysical effects, majoron emission can produce observable changes in μ and tau decay spectra for parameter values that substantially reduce the solar neutrino flux. A signature of the model is the possible observation of the decay μ→e+majoron.

16677 **Strongly coupled charged scalar in B and T decays.** Krawczyk, P.; Pokorski, S. (Institute for Theoretical Physics, Warsaw University,). *Physical Review Letters;* 60: No. 3, 182-185(18 Jan 1988).

Limits on charged-scalar Yukawa couplings from tau and B decays are discussed. They (and other existing limits) are consistent with "strong" couplings (≈1 for the third generation) even if the lightest scalar mass is in the range 20approx. <M/sub phi/approx. <100 GeV but saturated in this case. B(B→tauνX) and (for M/sub phi/>m/sub t/)B(T→tauνX) may be then as large as 30% and 70%, respectively. Both for M/sub phi/<m/sub t/ and M/sub phi/>m/sub t/ the potentially possible top-quark signature in pp-bar collisions is (tau+2 jets) final state. The upper limit for tau→vetaπ is ≈0.003%.

16678 **Angular distribution of W-boson pairs at a heavy Z resonance.** Nandi, S.; Rizzo, T.G. (Department of Physics, Oklahoma State University, Stillwater, Oklahoma 74078). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 1, 52-55(1 Jan 1988).

In theories with an extra U(1) gauge boson (Z_8) at low energies, W-boson pairs may be produced copiously by the process $e^+e^-\to Z_8\to W^+W^-$ at the Z_8 resonance. We show that the angular distribution of the W pairs (produced at the Z_8 resonance) is very different from that in the standard model, at the same center-of-mass energy, where it is dominated by t-channel neutrino exchange. These distributions will also be useful in distinguishing between the various models containing an extra Z boson.

16679 **Radiative corrections to the Z^0 resonance.** Alexander, J.P.; Bonvicini, G.; Drell, P.S.; Frey, R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 1, 56-70(1 Jan 1988). Contract AC03-76SF00515.

We review calculations of the radiative corrections to the Z^0 resonance, and we show that while the radiative corrections are quite large, they can be calculated and incorporated into the comparison with experiment so that there will be no significant theoretical uncertainties on the measurements of the Z^0 mass and width at the Stanford Linear Collider and the CERN collider LEP. We compare calculations based on matrix elements and structure-function methods, and discuss two Monte Carlo programs based on these calculations. We use the new calculations to refit the J/psi resonance.

16680 **Top-quark production at electron-positron colliders.** Jones, L.M.; Migneron, R. (Physics Department, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 1, 71-83(1 Jan 1988).

We create Monte Carlo sample events for the process $e^+e^-\to Z\to tt\text{-bar}\to b\mu^+\nu$/sub μ/b-bare-ν-italic-bar/sub e/, hadronized in two different ways. Events are studied for possible top-quark masses from 20 to 43 GeV. We demonstrate a method for determining the top-quark mass from the resulting jet data, and compare the differences in observable jet quantities resulting from the different methods of hadronization.

16681 **Testing couplings of three vector bosons through hadron collisions at Fermilab Tevatron energy.** Chang, C.; Lee, S.h. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 1, 101-111(1 Jan 1988).

A test for vector-boson trilinear couplings through hadron collisions at Fermilab Tevatron energy is investigated. The contributions from the standard model to the polarization cross section for W^+W^- pair production process are given and deviations from the standard model are considered. It is pointed out that some effects may be observable in Tevatron collider experiments.

16682 **Semileptonic decays of top mesons.** Jones, L.M.; Migneron, R. (Physics Department, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 1, 130-136(1 Jan 1988).

We use a QCD approach to model the hadrons produced in semileptonic decays of top-quark mesons. We examine the validity of a "one-jet-plus-lepton-pair" approach to the final state, and show that it is useful but not a completely accurate description. We also cover some additional properties of the hadrons in the final state: their multiplicity, quantum numbers, and energy distribution. A range of top-quark masses from 20 to 43 GeV is considered.

16683 **Number of neutrinos from W,Z hadroproduction: Last count.** Halzen, F.; Kim, C.S.; Willenbrock, S. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 1, 229-232(1 Jan 1988).

We determine the number of light neutrinos directly from data on (i) the production of W and Z bosons in pp-bar collisions and (ii) deep-inelastic scattering of leptons on hydrogen and deuterium. Ambiguities related to the use of structure functions are avoided. We conclude that at 95% confidence level, N/sub ν/≦3 and m(top)≦60 GeV. N/sub ν/ = 4 is allowed if the fourth neutri-

no is accompanied by a heavy charged lepton lighter than M/sub W/. .AE

16684 Decay B-bar^0→$\pi^+ l^- \nu$ to probe V/sub b//sub u/. Suzuki, M. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 1, 239-242(1 Jan 1988).

The semileptonic B decay, B-bar ^{0}→$\pi^+ l^- \nu$, is studied in a nonrelativistic picture by treating the pion correctly as a quasi-Nambu-Goldstone boson. The branching ratio is much larger than the value predicted by a two-body bound-state picture for the pion. This decay at the Y(4S) peak in e^+e^- annihilation will be one of the best suited processes to determine the Kobayashi-Maskawa mixing-matrix element V/sub b//sub u/.

16685 Multigluon processes and the Slavnov-Taylor identity. Kuo, W.; Slaven, D.; Young, B. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 1, 233-236(1 Jan 1988). Contract W-7405-ENG-82.

From the Slavnov-Taylor identity we show in the Feynman—'t Hooft gauge that the amplitude of a multigluon process can be simplified to satisfy the simple Ward-Takahashi identity with respect to all external gluon momenta involved, with the possible exception of at most one gluon. Then the simple form of the polarization projection of the Abelian case can be used for these gluons without the compensating ghost terms and thus simplify the cross-section calculation of multigluon processes. The method applies to processes which involve massive quarks as well as to processes which contain non-QCD interactions.

16686 Dynamics of skyrmion collisions in 3+1 dimensions. Allder, A.E.; Koonin, S.E.; Seki, R.; Sommermann, H.M. (W. K. Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, California 91125). *Physical Review Letters;* **59**: No. 25, 2836-2839(21 Dec 1987).

We calculate classical skyrmion collisions in 3+1 dimensions. Numerical integration of Hamilton's equations for the chiral fields is based on a staggered leap-frog method. We study collisions of defensive hedgehog solitons at various impact parameters for center-of-mass energies of 157, 432, and 885 MeV. Internal excitations of the skyrmions and meson emission are observed. The time evolution of the pion field and momentum and baryon densities is shown, as are deflection functions and inelasticities. Some results for skyrmion-antiskyrmion annihilation are presented.

16687 On the four-dimensional gauge theories from type II superstrings. Dixon, L.J.; Kaplunovsky, V.S.; Vafa, C. (Stanford Linear Accelerator Center, CA, USA; Stanford Univ., CA, USA. Dept. of Physics; Harvard Univ., Cambridge, MA, USA. Lyman Lab. of Physics). *Nuclear Physics* [*Section*] *B;* **294**: No. 1, 43-82(29 Nov 1987). Contract AC03-76SF00515.

We study the four-dimensional gauge theories which are associated with classical vacua of the type II superstring, i.e. which correspond to a superconformal field theory on the world-sheet. Using the fact that gauge symmetry arises from a supersymmetric affine Kac-Moody algebra, and demanding unitarity of the underlying world-sheet field theory, we show that no such vacua can yield the particle spectrum of the standard model. Of the gauge theories which are permitted by unitarity, we find that many can be constructed explicitly as orbifolds which twist the left- and right-moving degrees of freedom of the string asymmetrically; among these are three N=4 supersymmetry models - which have previously been constructed in a quite different fashion - and two N=1 supersymmetric models with chiral gauge representations for the massless fermions.

16688 Functional determinants on punctured Riemann surfaces and their application to string theory. Sonoda, H. (Lawrence Berkeley Lab., CA, USA). *Nuclear Physics* [*Section*] *B;* **294**: No. 1, 157-192(29 Nov 1987). Contract AC03-76SF00098.

We produce functional determinants on punctured Riemann surfaces by integrating the corresponding energy-momentum tensors. The results are applied to the bosonic closed string theory in two ways. We first give a rigorous proof of the relation between the scalar and ghost determinants for the singular metrics which are squares of meromorphic one-forms. This relation played an important role in the recent proof of the equivalence between the light-cone and Polyakov approaches given by D'Hoker and Giddings. Secondly we give explicit formulae for the scattering amplitudes as integrals over the moduli space of punctured Riemann surfaces.

16689 Complete solution of the chiral Schwinger model Hilbert space, constraints and Wess-Zumino terms. Boyanovsky, D. (California Univ., Davis, USA. Dept. of Physics; Stanford Linear Accelerator Center, CA, USA). *Nuclear Physics* [*Section*] *B;* **294**: No. 1, 223-243(29 Nov 1987). Contract AC03-76SF00515.

The chiral Schwinger model is completely solved by bosonization. The Hilbert space is constructed and it is found to be of indefinite metric. The quantum constraints that define the physical subspace are determined and the physical operators (those that commute with the constraints) are found. We compute their correlation functions and find that there is non-trivial fermion wave function renormalization const (Z/sub 2/) and vertex renormalization const (Z/sub 1//sup -1/) and that Z/sub 2/ = Z/sub 1/ although the theory has lost its gauge invariance because of the chiral anomaly. The addition of a Wess-Zumino (WZ) term is studied and the modifications of the constraints introduced by this term are analyzed. The physical gauge invariant correlation functions in the theory with the WZ term are found to be the same as the physical correlation functions of the theory with the WZ terms.

16690 Multiparticle superstring tree amplitudes. Itoyama, Hiroshi; Moxhay, P. (Fermi National Accelerator Lab., Batavia, IL, USA; Indiana Univ., Bloomington, USA. Dept. of Physics). *Nuclear Physics* [*Section*] *B;* **293**: No. 3/4, 685-708(16 Nov 1987). Contract AC02-84ER40125.

Covariant functional integral methods are used to derive formulas for (type I, type II, and heterotic) superstring tree amplitudes having arbitrary numbers of external ground-state bosons, thereby obtaining superstring generalizations of the Koba-Nielsen formula. The disk and projective plane diagrams of the type I superstring are calculated, and the divergences are shown to cancel in the case of gauge group SO(32); the dilaton tadpole is shown to vanish for SO(32) when the contributions from the disk and projective plane are added. The gauge fixing of the odd elements of the invariance groups of the amplitudes is shown to play an essential role.

16691 Neutron stars in relativistic hadron—quark models. Serot, B.D.; Uechi, H. (Physics Department and Nuclear Theory Center, Indiana University, Bloomington, Indiana 47405). *Annals of Physics (New York);* **179**: No. 2, 272-293(1 Nov 1987).

Neutron star properties are computed in relativistic models that contain both hadron and quark degrees of freedom. Neutron matter is assumed to have a low-density phase described by quantum hadrodynamics (QHD) and a high-density phase described by quantum chromodynamics (QCD). Several different QHD models and approximations are employed; all use parameters that reproduce the binding energy and density of equilibrium nuclear matter. Calculated neutron star properties depend primarily on the high-density equation of state and cannot be inferred from the symmetry energy or compressibility of equilibrium nuclear matter. If interactions are neglected in the QCD phase, the density of the hadron—quark phase transition is determined by one free parameter, which is the energy/volume needed to create a "bubble" that confines the quarks and gluons. Observed neutron star masses do not constrain this parameter, but stable neutron stars with quark cores can exist only for a limited range of parameter values. When second-order gluon-exchange corrections are included in the QCD phase, these conclusions are unchanged, and the parameter values that lead to stable hadron—quark stars are restricted even further. copyright 1987 Academic Press, Inc.

16692 **Heavy quark contributions to W pair production at hadron colliders.** Chang Chaohsi; Lee, S.C. (Fermi National Accelerator Lab., Batavia, IL, USA). *Physics Letters [Section] B;* 197: No. 1/2, 220-224(22 Oct 1987).

We investigate the effects of including fermion masses in calculating the W pair polarization density matrix for the process anti qq -> W/sup +/W/sup -/, and in testing the neutral scalar and vector boson couplings to W/sup +/W/sup -/ at hadron colliders. Appreciable effects are found at SSC energy and, in some cases, at Tevatron energy as well.

16693 **Detection of a charged Higgs via the decays H/sup +-/ -> YW/sup +-/ and H/sup +-/ -> ΘW/sup +-/.** Grifols, J.A.; Gunion, J.F.; Mendez, A. (Universidad Autonoma de Barcelona, Spain. Dept. de Fisica; California Univ., Davis, USA. Dept. of Physics; Lawrence Berkeley Lab., CA, USA). *Physics Letters [Section] B;* 197: No. 1/2, 266-268(22 Oct 1987).

We compute the branching ratios for a charged Higgs to decay to the final states YW/sup +-/ and ΘW/sup +-/. We assess signal and background rates for a high-energy hadron collider.

16694 **Heavy-quark systems.** Kwong, W.; Rosner, J.L.; Quigg, C. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois 60637). *Annual Review of Nuclear Science;* 37: No. 1, 325-382(1987).

This review is devoted to the subject of heavy quarks. Experimental data concerning particles containing heavy quarks is presented. The spectroscopy of bound states of charm, beauty, and the postulated top particles are discussed. (AIP)

16695 **Status of electroweak theory for heavy quark decays and CP violation.** Chau, L. (Dept. of Physics, Brookhaven National Lab., Upton, NY 11973). pp 13-51 of Particle and nuclear physics. Ning, H.; Chong-shi, W. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8509276—).

From International symposium on particle and nuclear physics; Beijing, China (2 Sep 1985).

The phenomena of quark mixing in weak interaction are described. The current experimental status of the mixing matrix, charm and beauty particle decays, and CP violations are reported. Future interesting experiments are pointed out, especially in the event that higher generations of quarks exist.

16696 **Gluon and massless gluino scattering using N=2 supersymmetry.** Parke, S.J. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 189-195 of Particle and nuclear physics. Ning, H.; Chong-shi, W. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8509276—).

From International symposium on particle and nuclear physics; Beijing, China (2 Sep 1985).

The use of N=2 supersymmetry to calculate the matrix elements for the scattering of gluons and massless gluinos, at tree level in perturbative QCD, is discussed. Four, five and six particle processes are used as examples.

16697 **Beta decay of polarized neutrons.** Bopp, P.; Dubbers, D.; Hornig, L.; Klemt, E.; Last, J.; Schuetze, H.; Freedman, S.J.; Schaerpf, O. (Physikalisches Institut der Universitaet Heidelberg, Germany). *AIP (American Institute of Physics) Conference Proceedings;* 125: No. 1, 881-888(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Beta decay of polarized neutrons has been studied with the superconductive spectrometer PERKEO at the Institut Laue-Langevin. The energy spectrum of the β-decay asymmetry has been measured for the first time; from the absolute value of the asymmetry we obtain a new value for the ratio of weak coupling constants g/sub A//g/sub V/, which is compared to similar data from hyperon decays. The measurement of further weak interaction parameters from neutron decay is in progress.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 16352, 16667, 16744, 16745, 16754, 16973

16698 **(DOE/ER/40048—41-N7) A status report of some symmetries.** Henley, E.M. (Washington Univ., Seattle (USA). Dept. of Physics). 1987. Contract AC06-81ER40048. 21p. (CONF-8707144—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004228/JAW.

From Workshop on quarks in hadrons and nuclei; Erice, Italy (16 Jul 1987).

This report gives a status report on some symmetries in nuclear physics. Discussed are charge symmetry and charge independence, parity and time reversal invariance. 60 refs., 16 figs., 3 tabs.

16699 **(DOE/ER/40048—43-N7) Symmetries and nuclei.** Henley, E.M. (Washington Univ., Seattle (USA). Dept. of Physics). 1987. Contract AC06-81ER40048. 15p. (CONF-8709221—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004231/JAW.

From Interactions and structures in nuclei conference; Sussex, UK (7 Sep 1987).

Nuclei are very useful for testing symmetries, and for studies of symmetry breaking. This thesis is illustrated for two improper space-time transformations, parity and time-reversal and for one internal symmetry: charge symmetry and independence. Recent progress and present interest is reviewed. 23 refs., 8 figs., 2 tabs.

16700 **(DOE/ER/40048—44-N7) Charge symmetry breaking and meson mixing.** Miller, G.A. (Washington Univ., Seattle (USA). Dept. of Physics). 1987. Contract AC06-81ER40048. 10p. (CONF-8708203—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004232/JAW.

From Workshop on physics with light mesons; Los Alamos, NM, USA (14 Aug 1987).

The possibility of new experiments involving rho, ω, eta, and eta mesons has stimulated this discussion of current knowledge of meson mixing as caused by charge symmetry breaking. These questions are addressed: What is meson-mixing? Why is it interesting? How is rho^0-ω mixing measured? What are the results and expectations? Consequences for nuclear forces. The available information may be summarized by the statements: there is a strong signature for rho^0-ω mixing observed in the reaction $e^+e^- \rightarrow \pi^+\pi^-$; the process of π^0-eta mixing is observed indirectly in the decay eta $\rightarrow 3\pi$, but this reaction is difficult to analyze. At present there is some evidence for rho^0-ω mixing in nuclear forces. 17 refs., 4 figs.

16701 **(DOE/ER/40153—4) Research in particle theory: Annual progress report for the period January 1, 1987-December 31, 1987.** Mansouri, F.; Suranyi, P.; Witten, L.; Wijewardhana, R. (Cincinnati Univ., OH (USA)). Dec 1987. Contract FG02-84ER40153. 25p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004351/JAW.

New compactified superstring models in four dimensions were developed, which have N = 1 supersymmetry and gauge groups such as SO(10) and SU(5). In this compactification scheme, the spin connection is not embedded in the gauge field. The models have a small number of generations and calculable parameters. A new family of static, axially symmetry selections of Einstein's equations with sources that have toroidal topology were found, which have several known solutions as special cases. Monte Carlo simulations were performed on two-dimensional conformal field theories with Z_4, Z_7, and Z_9 symmetry. The conformal anomaly and anomalous dimensions were found in agreement with the assumption that these models are manifestations of theories of massless free bosons with twisted boundary conditions, the dimensions of which have also been found from a calculation of the generating function on a complex torus. A self-consistency condition, extending modular invariance to include Abelian symmetry groups and twisted boundary conditions has been derived. The spectrum and the observables of a free massless O(N) parafermion theory of order Q in two dimensions were shown to be related to, but not identical with, a free fermion theory with O(N) x O(Q) symmetry. The Virasoro and the O(N) Kac-Moody algebras of these theories were given. The spectra and the zero-point energies of parastring models were studied.

A physical interpretation of these models as theories of Preons was suggested. Dynamical electroweak symmetry breaking and mass generation for quarks and leptons were studied. A mechanism for mitigating the flavor-changing neutral current problem endemic to such theories were proposed. 46 refs.

16702 **(DOE/ER/40157—T2) Symmetry problems in particle physics: Progress report.** Kabir, P.K.; Fishbane, P.F. (Virginia Univ., Charlottesville (USA)). Jan 1988. Contract FG05-84ER40157. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004927/JAW.

Progress is reported in the areas of family symmetry and the fermion mass matrix, consequences of heavy isosinglet fermions, and dynamics of confinement. Theorems were discovered relating the polarization of the transmitted neutrons after passage through a polarized medium to the initial polarization. (LEW)

16703 **(DOE/ER/40224—48) Phenomenology based on superstring inspired E_6 group.** Deshpande, N.G. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Sep 1987. Contract FG06-85ER40224. 16p. (CONF-8705241—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004548/JAW.

From 10. WARSAW symposium on elementary particle physics; Kazimierz, Poland (25 May 1987).

We present mass limits and properties of extra gauge bosons that might occur at low energy in superstring inspired E_6 models. Both rank 5 and 6 cases are considered. We then present the properties of the quark singlets that also occur in these models. 26 refs., 5 figs., 4 tabs.

16704 **(DOE/ER/40224—49) Discovery limits of new gauge bosons of Sp/sup L/(6) x U(1).** Barger, V.; Deshpande, N.G.; Kuo, T.; Bagneid, A.; Pakvasa, S.; Whisnant, K. (Wisconsin Univ., Madison (USA); Oregon Univ., Eugene (USA); Purdue Univ., Lafayette, IN (USA); Hawaii Univ., Honolulu (USA); Florida State Univ., Tallahassee (USA)). Jul 1987. Contract FG06-85ER40224. 5p. (OITS—362; CONF-8705163—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004810/JAW.

From Madison SSC workshop: from colliders to supercolliders; Madison, WI, USA (11 May 1987).

We present production cross-sections for additional gauge bosons W' and Z' of Sp/sub L/(6) x U(1) Gauge Group at the SSC. 3 refs., 2 figs.

16705 **(EFI—895(46)-86) Dirac and Weyl fermion dynamics on two-dimensional surface.** Kavalov, A.R.; Sedrakyan, A.G.; Kostov, I.K. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700160/JAW.

Fermions on 2-dimensional surface, embedded into a 3-dimensional space are investigated. The determinant of induced Dirac operator for the Dirac and Weyl fermions is calculated. The reparametrization-invariant effective action is determined by conformal anomaly (giving Liouville action) and also by Lorentz anomaly leading to Wess-Zumino term, the structure of which at d=3 is determined by the Hopf topological invariant of the $S^3 \to S^2$ map. 13 references.

16706 **(IN2P3—86-01, pp 1-135) P, C, T, baryonic number and leptonic number.** Depommier, P. (Montreal Univ., Canada). 1986. (In French). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751391/JAW. (CONF-8609338—).

From Joliot Curie school of nuclear physic: symmetries and nuclear physics; Maubuisson, France (15 Sep 1986).

Symmetries such as P (parity), C (particle-antiparticle conjugation), T (time reversal), B (baryon number), L (lepton number and Li (partial lepton number) are studied in this lecture. Essentially physics enclosed in formulas and theorems are described, together with principles which are basis of experimental methods. Several historical experiments and some current developments are chosen. The different subjects are presented in the theoretical frame of the standard model.

16707 (IN2P3—86-01, pp 261-296) **Chiral symmetry.** Guichon, P.A.M. (Lyon-1 Univ., 69 - Villeurbanne, France. Inst. de Physique Nucleaire). 1986. (In French). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751391/JAW. (CONF-8609338—).

From Joliot Curie school of nuclear physic: symmetries and nuclear physics; Maubuisson, France (15 Sep 1986).

Chiral symmetry is first explained by considerations about quarks and Quantum Chromodynamics. Then it is shown how the symmetry has been suggested by the weak interactions phenomenology. The hypothesis, current conservation and current algebra, are formulated. After a comment about the Goldstone realization one derives, as an illustration, the threshold pion electroproduction amplitude. Finally one explains how to build a chiral invariant Lagrangian and the rules for use.

16708 (IN2P3—86-01, pp 473-491) **Particle physics: symmetry research.** Girardi, G. (Grenoble Univ., 74 - Annecy-le-Vieux, France. Lab. de Physique des Particules). 1986. (In French). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751391/JAW. (CONF-8609338—).

From Joliot Curie school of nuclear physic: symmetries and nuclear physics; Maubuisson, France (15 Sep 1986).

We present an overview of the use of gauge symmetries in particle physics. The lecture was, deliberately, cleared of technical aspects. We emphasize the logical steps which lead to the concepts of Grand Unification and Supersymmetry which are developed in sections 2 and 3. In the final section, we set ajar the door to Kaluza-Klein theories, formulated in spaces with more than 4 dimensions and might lead to The Unified Theory.

16709 **(LBL—24150) Techniques for finding supersymmetry at the SSC.** Barnett, R.M.; Klopfenstein, C.; Wang, E.; Pauss, F.; Gunion, J.F.; Haber, H.E.; Baer, H.; Drees, M.; Tata, X.; Hagiwara, K. (Lawrence Berkeley Lab., CA (USA); European Organization for Nuclear Research, Geneva (Switzerland); California Univ., Davis (USA). Dept. of Physics; California Univ., Santa Cruz (USA). Dept. of Physics; Florida State Univ., Tallahassee (USA). Dept. of Physics; Wisconsin Univ., Madison (USA). Dept. of Physics). Oct 1987. Contract AC03-76SF00098;AM03-76SF00010;AS03-80ER70191. 32p. (CONF-870739—9). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003869/JAW.

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

We examine the signatures at the SSC for supersymmetry for much of the (minimal) supersymmetric model parameter space. In particular, we survey the decay modes and signatures of gluinos and squarks. Gluinos (squarks) decay to two (one) jets and a chargino or neutralino (chi-tilde). This chi-tilde may be the (stable) lightest supersymmetric particle, LSP (and lead to missing energy). Or chi-tilde may have a two-body decay to another chi-tilde plus a W, Z or Higgs boson. Finally, it may have a three-body decay to the LSP plus q anti q, e nu, μnu, ee or $\mu\mu$. Only for very light gluinos and squarks is the decay mode containing the LSP dominant. In fact, for gluinos and squarks over 500 GeV, the decays to W and Z bosons dominate for much of parameter space. We estimate the backgrounds for the case in which both gluinos decay to Z bosons. The decays of gluinos and squarks which go directly to the LSP lead to very large missing energy. We report the initial results of a study of the backgrounds for this process. 22 refs., 11 figs., 3 tabs.

16710 **Supersymmetric-charged-Higgs-boson production at the Superconducting Super Collider.** E-acute-accentboli, O.J.P.; Marques, G.C.; Novaes, S.F.; Natale, A.A.; Pulido, J.M.R. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review [Section] D: Particles and Fields;* 37: No. 3, 837-839(1 Feb 1988).

We analyze the production of supersymmetric charged Higgs bosons via vector-boson fusion at Superconducting Super Collider energies. This process leads to a measurable cross section only for a very limited range of masses of the charged Higgs

bosons: M/sub H//sub <//sub +- //sub =/≤300—400 GeV when M/sub H//sub >2//sup =/>40 GeV.

16711 **Gauge-boson mass shifts for extended Higgs sectors.** Moore, S.R.; Young, B.; Whisnant, K. (Department of Physics and Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] D: Particles and Fields;* 37: No. 1, 179-189(1 Jan 1988). Contract W-7405-ENG-82.

We calculate the one-loop radiative corrections to gauge-boson masses in SU(2)/sub L/ x U(1)/sub Y/ electroweak gauge models with an extended Higgs sector in an on-shell renormalization scheme. Current gauge-boson mass measurements restrict certain Higgs-boson masses to lie below the unitarity bound. Future precise measurements of the Z-boson mass can significantly reduce this limit. We also compare our results to previous calculations for the shift in the rho parameter.

16712 **E_6 family unification, mirror fermions, and new low-energy physics.** Barr, S.M. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] D: Particles and Fields;* 37: No. 1, 204-209(1 Jan 1988). Contract AC02-76CH00016.

The group E_6 is investigated from the point of view of family unification. A Peccei-Quinn symmetry is used to protect the light fermions from acquiring a superlarge mass. It is found that if this protection is to be maintained without destroying perturbative unification three families are uniquely picked out with a family group SU(3)/sub fam/$\subset E_6$ x SU(3)/sub fam/$\rightarrow E_6$. A relation between the (V-A)/(V+A) hierarchy and the hierarchy of M/sub PQ//M/sub GUT/ is found. It is also found that, in addition to mirror families, several exotic fermions characteristically remain light.

16713 **Dynamical composite models of electroweak bosons.** Suzuki, M. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] D: Particles and Fields;* 37: No. 1, 210-218(1 Jan 1988). Contract AC03-76SF00098.

It is demonstrated explicitly in a 1/N expansion of cutoff field theory that tightly bound vector particles made of fermion pairs behave exactly like gauge bosons as the binding becomes infinitely strong. Two examples of composite models for electroweak gauge bosons are constructed by breaking global electroweak SU(2) symmetry explicitly. The low-energy effective Lagrangian of these models is identical to that of the standard theory based on spontaneously broken gauge symmetry with the physical Higgs-boson mass let to infinity. A small deviation from gauge symmetry due to compositeness is computed for three-point vertices to illustrate how the compositeness effect manifests itself.

16714 **Exact construction of (0,2) Calabi-Yau manifolds.** Cvetic, M. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6396). *Physical Review Letters;* 59: No. 25, 2829-2831(21 Dec 1987).

It is shown that (0,2) Calabi-Yau manifolds as exact solutions at the string tree level can be obtained from a class of (2,2) Calabi-Yau manifolds, which are constructed as blown-up Z/sub N/ orbifolds.

16715 **Heterotic-string Lagrangean in the bosonic formulation.** Labastida, J.M.F.; Pernici, M. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Physical Review Letters;* 59: No. 22, 2511-2514(30 Nov 1987).

We consider the Becchi-Rouet-Stora-Tyutin quantization of the N = 2 supersymmetric Siegel Lagrangean which is obtained by truncation of the N = 2 spinning string. We show that this Lagrangean describes four chiral bosons and that it can be consistently coupled to N = (1,0) supergravity. Using this system we propose a Lagrangean for the heterotic string in the bosonic formulation.

16716 **Signatures of exotic fermions and other new "low-energy" phenomena in superstring E/sub 6/.** Rosner, J.L. (Enrico Fermi Institute and Dept. of Physics, Univ. of Chicago, 5640 S. Ellis Ave., Chicago, IL 60637). pp 196-208 of Particle and nuclear physics. Ning, H.; Chong-shi, W. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8509276—).

From International symposium on particle and nuclear physics; Beijing, China (2 Sep 1985).

Superstring theories have drawn renewed attention to the exceptional Group E/sub 6/ as a grand unified theory. The authors discuss the extra U(1) symmetries (beyond that in the standard SU(3)xSU(2)xU(1) model) that arise when E/sub 6/ is broken in such theories. These extra U(1)'s must lead to at least one extra neutral gauge boson, called Z', for which they give mass limits and branching ratios. Neutral current effects of this Z' and its direct production are discussed briefly. Finally, some signatures are noted of exotic fermions to which Z' can decay.

6454 Field Theory

REFER ALSO TO CITATION(S) 16314, 16315, 16354, 16361, 16362, 16505, 16593, 16675, 16679, 16683, 16685, 16686, 16687, 16688, 16689, 16690, 16711, 16712, 16713, 16716, 17191, 17192, 17193, 17194, 17195, 17196, 17197, 17198, 17199, 17200, 17204, 17210, 17231, 17384

16717 **(BNL—40511) Chiral transition in lattice gauge theories with Higgs and fermions.** Lee, I-Hsiu. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 14p. (CONF-8709225—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003902/JAW.

From International symposium on field theory on the lattice; Seillac, France (28 Sep 1987).

Analytic and numerical studies of the lattice gauge theories with both Higgs and fermion fields are reported. A chiral transition is found in a wide class of such theories, both abelian and non-abelian. This transition separates each phase diagram into two regions, one with spontaneous chiral symmetry breaking and the other with explicit chiral symmetry. The transition is second order where probed. In models where Yukawa couplings are present, there exists a critical value of this coupling below which chiral transition still occurs. Some physical implications are noted. 10 refs., 5 figs.

16718 **(BNL—40512) Algorithmic alternatives.** Creutz, M. (Brookhaven National Lab., Upton, NY (USA)). Nov 1987. Contract AC02-76CH00016. 12p. (CONF-8709225—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003905/JAW.

From International symposium on field theory on the lattice; Seillac, France (28 Sep 1987).

A large variety of Monte Carlo algorithms are being used for lattice gauge simulations. For purely bosonic theories, present approaches are generally adequate; nevertheless, overrelaxation techniques promise savings by a factor of about three in computer time. For fermionic fields the situation is more difficult and less clear. Algorithms which involve an extrapolation to a vanishing step size are all quite closely related. Methods which do not require such an approximation tend to require computer time which grows as the square of the volume of the system. Recent developments combining global accept/reject stages with Langevin or microcanonical updatings promise to reduce this growth to V/sup 4/3/.

16719 **(DOE/ER/10587—T5) Task D: Topics in string theory: Progress report, July 1, 1987-April 30, 1988.** Martinec, E. (Chicago Univ., IL (USA)). Dec 1987. Contract AC02-80ER10587. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004532/JAW.

Progress is reported in the areas of: reformulating standard conformal quantum field theory correlation functions in the language of modular geometry; phenomenological predictions of string theory; discrete series of conformal field theories; and formulation of string theory dynamics in terms of the general renormalization group framework. (LEW)

16720 (DOE/ER/40048—35-N7) The non-topological, color dielectric, soliton model. Wilets, L. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory). 1987. Contract AC06-81ER40048. 12p. (CONF-8707144—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004166/JAW.

From Workshop on quarks in hadrons and nuclei; Erice, Italy (16 Jul 1987).

An essential feature of quantum chromcodynamics is the confinement of quarks and gluons in localized, color-singlet states. This has been effected by models through the introduction of a color function κ and magnetic permittivity $\mu = \kappa^{-1}$. In regions of confinement, such as the interior of a "bag," $\kappa \simeq 1$, while in the vacuum, $\kappa \to 0$. Although the discussion is concerned primarily with the Friedberg-Lee non-topological soliton model, much of the material presented carries over to other color-dielectric soliton models and in some cases analogies or differences are indicated. Soliton models are characterized by the introduction of a scalar field (here denoted by σ) which is to be identified with the gluon condensate. The σ-field is both a Lorentz scalar and color singlet; it has the quantum numbers of the vacuum. It is not a fundamental field, but an effective field. It plays a role similar to plasmons in an electron gas, or deformation modes in nuclear collective motion. The model has been extended beyond the original classical interpretation to permit quantumdynamical calculations. The effective Lagrangian contains the field and its time derivative, so that a Hamiltonian can be constructed which contains the field and its conjugate momentum. Methods familiar from nuclear theory can therefore be used to construct fully quantal states of the system. In doing so, one can employ the coherent (or, more generally, the single mode) state approximation for the scalar field part of the state vector. This is related to the mean field approximation, but is quantal. 26 refs., 1 fig.

16721 (DOE/ER/40219—3) [Research in theoretical physics]: Results from last year 1986/87. Frampton, P.H.; Ng, Y.J.; Van Dam, H. (North Carolina Univ., Chapel Hill (USA). Dept. of Physics and Astronomy). 1987. Contract FG05-85ER40219. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004922/JAW.

This paper briefly discusses the following topics: particle phenomenology, superstring formalism, superstring applications, narrow electron-positron peaks in heavy-ion collisions and the confining phase of QED, novel bosonic strings, interactions involving higher spin massless particles, and classical action at a distance theories which contain a cutoff. (LSP)

16722 (DOE/ER/40224—33) Signatures for exotic quark singlets from superstrings. Barger, V.; Deshpande, N.G.; Gunion, J.F. (Wisconsin Univ., Madison (USA). Phenomenology Inst.; Oregon Univ., Eugene (USA). Inst. of Theoretical Science; California Univ., Davis (USA). Dept. of Physics). Sep 1986. Contract FG06-85ER40224. 6p. (UCD—86-22; MAD/PH—308). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004157/JAW.

We consider various scenarios, at Superconducting Super Collider energy and luminosity, for detection of the extra colored, weak isospin singlet, charge -1/3 heavy fermion resulting from E_6 compactification in superstring theories.

16723 (DOE/ER/40224—35) Extra gauge bosons and E_6 fermions from superstrings. Deshpande, N.G. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). 1986. Contract FG06-85ER40224. 6p. (CONF-860701—93; OITS—338). NTIS, PC A02. Order Number DE88003523/JAW.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

We present mass limits, production rates and forward-backward asymmetries of extra gauge bosons that could occur in some string inspired E_6 models. We also discuss the properties of the new fermions in the 27 representation.

16724 (DOE/ER/40224—56) Physics parameters for new W's and Z's. Whitaker, J.S.; Deshpande, N. (Boston Univ., MA (USA). Dept. of Physics; Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Oct 1987. Contract FG06-85ER40224. 8p. (OITS—373). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004238/JAW.

New massive neutral or charged gauge bosons are expected in any extension of the gauge structure of Standard Model. Observation of such new particles by their decays to quark jets will be very difficult in the face of high QCD backgrounds. The leptonic decay modes of such new particles would provide clear observable signatures up to masses around 5 TeV under nominal SSC running conditions. We specify the physics parameters which characterize these channels. 11 refs., 3 figs.

16725 (DOE/ER/40272—47) The early years of string theory: The dual resonance model. Ramond, P. (Florida Univ., Gainesville (USA). Dept. of Physics). Oct 1987. Contract FG05-86ER40272. 60p. (CONF-8707141—2; UFTP—87-19). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003521/JAW.

From Theoretical advanced summer institute; Santa Fe, NM, USA (6 Jul 1987).

This paper reviews the past quantum mechanical history of the dual resonance model which is an early string theory. The content of this paper is listed as follows: historical review, the Veneziano amplitude, the operator formalism, the ghost story, and the string story. (LSP)

16726 (DOE/ER/40273—2) [Research in theoretical nuclear physics]: Progress report. Robson, D. (Florida State Univ., Tallahassee (USA). Dept. of Physics). 1987. Contract FG05-86ER40273. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003435/JAW.

Investigations in the second year of this three year contract have continued on two broad fronts. The first area is Hamiltonian Lattice Gauge Theory which is a collaborative effort and the second area is in models of hadrons and hadronic interactions based on quarks, pions and the basic QCD symmetries, i.e., chiral symmetry and local SU(3) gauge invariance. 7 refs.

16727 (EFI—876(27)-86) Non-integrability of time-dependent spherically symmetric Yang-Mills equations. Matinyan, S.G.; Prokhorenko, E.V.; Savvidy, G.K. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700151/JAW.

The integrability of time-dependent spherically symmetric Yang-Mills equations is studied using the Fermi-Pasta-Ulam method. The phase space of this system is shown to have no quasi-periodic motion specific for integrable systems. In particular, the well-known Wu-Yang static solution is unstable, so its vicinity in phase is the stochasticity region. 29 references, 8 figures.

16728 (EFI—890(41)-86) Stochasticity of time-dependent spherically symmetric solutions of Yang-Mills equations. Matinyan, S.G.; Prokhorenko, E.V.; Savvidy, G.K. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700157/JAW.

It is shown that time-dependent spherically symmetric Yang-Mills equations are a non-integrable system. In particular, the phase space in the vicinity of Wu-Yang static solution is the stochasticity region. 7 references, 3 figures.

16729 (FNAL/C—87/167-A) Zero temperature quark matter equation of state. Grassi, F. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1987. Contract AC02-76CH03000. 29p. (CONF-8709219—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003408/JAW.

From Workshop on variational calculations in quantum field theory; Wangerooge, F.R. Germany (1 Sep 1987).

An equation of state is computed for a plasma of one flavor quarks interacting through some phenomenological potential, in the Hartree approximation, at zero temperature. Assuming that the confining potential is scalar and color-independent, it is shown that the quarks undergo a first-order mass phase transition. In addition, due

to the way screening is introduced, all the thermodynamic quantities computed are independent of the actual shape of the interquark potential. This equation of state is then generalized to a potential with scalar and vector components, Fock corrections are discussed and the case of a several quark flavor plasma is studied. 19 refs., 2 figs.

16730 **(IFVE-OTF—85-89) Motion of color charge in the field of chromoelectric hedge-hog.** Alekseev, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700198/JAW.

Submitted to the journal Theor. Math. Phys.

The consideration is given to the motion of a probe classical color charge in a static non-Abelian chromoelectric spherically symmetric field. The gauge group is SU(2). The total moment conservation allows one to pass to the problem of motion of an electrically charged particle in an external electromagnetic field. The electric field potential becomes angle-dependent. Apart from scattering trajectories, finite ones associated with bound states, are shown to exist. The motion of the color charge near the potential minimum is investigated in detail. The angular motion of a color charge resembles that of a heavy symmetric top. 7 references, 3 figures.

16731 **(INIS-BR—865) Equations of motion of a particle interacting with a scalar field.** Sato, N.K. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1984. 61p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700201/JAW.

The equations of motion of a particle (nucleon) interacting with a escalar (mesonic) field are derived by the energy momentum tensor moments method of Papapetrou. After a detailed study of the mesonic radiation field the expression of the reactive radiation force of the field upon the particle is established.

16732 **(INIS-BR—906) Generalized transport equation.** Vasconcellos, A.R.; Luzzi, R. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). Nov 1987. 1p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700875/JAW.

16733 **(ITEP—70(1985)) Decay of false vacuum in presence of soft fermionic and bosonic modes bound on soliton.** Voloshin, M.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700255/JAW.

Decay rate of a false vacuum in (1+1) dimensions is considered in a situation when there are zero or soft fermionic or bosonic modes which are localized on the soliton that converts the false vacuum into a lower one. It is shown that up to exponentially small corrections the decay rate is contributed independently by soliton states, corresponding to different values of the occupation numbers of the soft modes. The contribution of each of the soliton states is given by the formula derived in an earlier work. 9 references.

16734 **(ITEP—140(1985)) Destruction of false vacuum by massive particles.** Selivanov, K.B.; Voloshin, M.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700256/JAW.

The rate of false vacuum decay in (1 + 1) dimensions induced by a massive boson or fermion particle which serves as a center of nucleation of critical bubble of the lower vacuum is calculated. The pesence of a particle gives an exponential enhancement of the decay rate and sufficiently heavy particles practically immediately blow up the false vacuum. The particle itself is carried away to infinity in a form of zero mode bound on soliton. 9 references, 1 figure.

16735 **(ITEP—169(1985)) Explicit form of non-Abelian consistent chiral SUSY anomaly.** Krivoshchekov, V.K.; Medvedev, P.B.; Chekhov, L.O. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700257/JAW.

An attempt is made to derive the consistent chiral anomaly using invariant SUSY regularization being in fact a particular case of the loop regularization. The authors have succeeded in avoiding any parameter integration in favour of a simple expansion over 1/ M^2, where M/sub i/ are regularizing parameters with dimension of mass. The answer obtained is of the form of the infinite series in e/ sup v/-1 and 1-e/sup -v/. This enables one to perform direct verification of the chiral anomaly consistency conditions in the closed form. Up to the third order the derived formula reproduced the component result in the Wess-Lumino gauge. In the Abelian limit it is proved that the exact answer is converted into a compact form of the third-order polynomial in V. 11 references.

16736 **(JINR—R-2-86-849) Computational quantum field theory.** Makhaldiani, N.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700918/JAW.

The computational quantum field theory (CQFT) is considered as a part of the computational physics. The main mathematical structures of the CQFT are described in the case of quantum chromodynamics. As examples of the application of the CQFT methods the calculation of the topological susceptibility and the gluon condensates are considered. 54 refs.; 1 fig.; 1 tab.

16737 **(LA-UR—87-4146) The hybrid Monte Carlo Algorithm and the chiral transition.** Gupta, R. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 10p. (CONF-8709225—3). NTIS, PC A02. Order Number DE88004305/JAW.

From International symposium on field theory on the lattice; Seillac, France (28 Sep 1987).

In this talk the author describes tests of the Hybrid Monte Carlo Algorithm for QCD done in collaboration with Greg Kilcup and Stephen Sharpe. We find that the acceptance in the global Metropolis step for Staggered fermions can be tuned and kept large without having to make the step-size prohibitively small. We present results for the finite temperature transition on 4^4 and 4×6^3 lattices using this algorithm.

16738 **(LAPP-TH—173) Differential algebras in field theory and their anomalies: two examples.** Stora, R. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Jun 1986. 12p. (CONF-8606369—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751636/JAW.

From C.I.R.M. meeting on harmonic maps; Luminy, France (9 Jun 1986).

The expression of gauge symmetries in local field theory proceeds via the construction of some differential algebras as was remarked some ten years ago. The construction relevant to Yang Mills theories is recalled. As another popular example, we have chosen to describe the covariant quantization of the free bosonic string in the metric background gauge.

16739 **(LBL—24128) Compositeness and QCD at the SSC.** Barnes, V.; Blumenfeld, B.; Cahn, R.; Chivukula, S.; Ellis, S.; Freeman, J.; Heusch, C.; Huston, J.; Kondo, K.; Morfin, J. (Purdue Univ., Lafayette, IN (USA); Johns Hopkins Univ., Baltimore, MD (USA); Lawrence Berkeley Lab., CA (USA); Boston Univ., MA (USA); Washington Univ., Seattle (USA); Fermi National Accelerator Lab., Batavia, IL (USA)). 12 Oct 1987. Contract AC03-76SF00098. 47p. (CONF-870739—10; BU-HEP—87-29). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003910/ JAW.

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

Compositeness may be signaled by an increase in the production of high transverse momentum hadronic jet pairs or lepton pairs. The hadronic jet signal competes with the QCD production of jets, a subject of interest in its own right. Tests of perturbative QCD at the SSC will be of special interest because the calculations are expected to be quite reliable. Studies show that compositeness up to a scale of 20 to 35 TeV would be detected in hadronic jets at the SSC. Leptonic evidence would be discovered for scales up to 10 to 20 TeV. The charge asymmetry for leptons would provide information on the nature of the compositeness interaction. Calorimetry will play a crucial role in the detection of compositeness in the hadronic jet signal. Deviations from an e/h response of 1 could mask the effect. The backgrounds for lepton pair production seem manageable. 30 refs., 19 figs., 10 tabs.

16740 **(RAL—86-048) Topology and the eta' mass in SU(3) lattice gauge theory.** Hock, J.; Teper, M.; Waterhouse, J. (Rutherford Appleton Lab., Chilton (UK)). Jun 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750834/JAW.

The topological charge density of the (Monte Carlo generated) SU(3) vacuum is measured. The algorithm is designed to be robust against lattice artifacts. The resulting topological susceptibility is found to vary with g^2 like the string tension (within errors) which allows one to extract a value in physical units: Xsub(t) approx. (190 +- 10 MeV)^4 in good agreement with the Witten-Veneziano mass formula. The topological susceptibility is found to be strongly suppressed as the temperature is raised through the deconfining transition: the quantum Usub(A)(1) symmetry is effectively restored in the deconfined phase.

16741 **(RAL—86-092) String theory considered as a local gauge theory of an extended object.** Chan Hongmo; Tsou Sheungtsun. (Rutherford Appleton Lab., Chilton (UK)). Nov 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750947/JAW.

In attempting to understand more about the physical origin of the so-called 'chordal gauge symmetry' in string field theory it is found that one can, at least formally, consider the theory as a generalised local gauge theory. However, the fundamental object is no longer a point, as in ordinary gauge theory, but a point with a tail, and it is the motion of this tail which represents the internal gauge degree of freedom. Moreover, the differential geometry is based on the non-abelian conformal group instead of the usual translation group.

16742 **(RRK—87-16) Geometry, heat equation and path integrals on the Poincare upper half-plane.** Kubo, Reijiro. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Aug 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752000/JAW.

Geometry, heat equation and Feynman's path integrals are studied on the Poincare upper half-plane. The fundamental solution to the heat equation $\delta f/\delta t = \Delta/\text{sub } H/f$ is expressed in terms of a path integral defined on the upper half-plane. It is shown that Kac's proof that Feynman's path integral satisfies the Schroedinger equation is also valid for our case.

16743 **Majorana Feynman rules.** Gates, E.I.; Kowalski, K.L. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). *Physical Review [Section] D: Particles and Fields;* 37: No. 4, 938-945(15 Feb 1988).

Nontrivial relative-sign ambiguities are pointed out in previous statements of the Feynman rules for field theories containing Majorana fermions. New graphical rules which resemble those for Dirac fermions in their natural association of momentum and fermion flows are proposed that have only those signature problems normally expected for fermions. The new rules utilize only the conventional fermion propagator and involve vertices without appended charge-conjugation matrices. The number of two-Majorana—boson vertices is reduced from six to two.

16744 **Non-Abelian gauge invariance and the infrared approximation.** Cho, H.h.; Fried, H.M.; Grandou, T. (Physique Theorique, Universite de Nice, Physique Theorique, Parc Valrose, 06034 Nice Cedex, France). *Physical Review [Section] D: Particles and Fields;* 37: No. 4, 960-968(15 Feb 1988).

Two constructions are given of infrared approximations, defined by a nonlocal configuration-space restrictions, which preserve the local, non-Abelian gauge invariance of SU(N) two-dimensional QCD (QCD_2). These continuum infrared methods are used to estimate the quenched order parameter <psi-barpsi> in the strong-coupling, or chiral, limit and are compared to a previous calculation where gauge invariance was not manifest. Both constructions provide results which, in the chiral limit, differ from each other and from the previous estimation by an inessential, multiplicative scaling factor.

16745 **Perturbative tests of a lattice fermion proposal of Quinn and Weinstein.** Bodwin, G.T.; Kovacs, E.V. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] D: Particles and Fields;* 37: No. 4, 1008-1013(15 Feb 1988). Contract W-31-109-ENG-38.

We discuss a proposal of Quinn and Weinstein for incorporating fermions into lattice gauge theory and analyze it in the context of weak-coupling perturbation theory. In two dimensions we find that, because of a special property of the Hamiltonian formulation, one recovers the physics of the continuum theory as the lattice spacing tends to zero. In four dimensions we find that the transverse photon develops a quadratically divergent mass. Consequently, in order to obtain a satisfactory continuum limit, one would need to augment the Quinn-Weinstein proposal through the inclusion of additional counterterms. We argue that the construction of such counterterms would entail at least a partial breaking of the chiral symmetry.

16746 **Dual long-distance QCD.** Baker, M.; Ball, J.S.; Zachariasen, F. (Department of Physics, FM-15, University of Washington, Seattle, Washington 98195). *Physical Review [Section] D: Particles and Fields;* 37: No. 4, 1036-1063(15 Feb 1988).

We propose an explicit form for the long-range limit of the SU(N) Yang-Mills Lagrangian expressed as a function of the dual (color-electric) vector potentials. While we cannot rigorously derive the Lagrangian, it can be made plausible that it follows from conventional Yang-Mills theory. This dual long-distance QCD Lagrangian has many of the properties of a magnetic superconductor. It has classical solutions corresponding to confined tubes of quantized electric color flux which result from a dual Meissner effect. However, the confining pressure is not produced by a scalar Higgs field, as in ordinary superconductivity, but by a magnetic condensate field which arises naturally from the nonlocal form of the dual Lagrangian. Within the classical approximation, we find the explicit distribution of color fields surrounding a flux tube. Semiclassical quantization around this solution can be expected to yield the QCD string, and the semiclassical expansion parameter is 1/N, where N is the number of colors.

16747 **Inequivalent quantizations and fundamentally perfect spaces.** Imbo, T.D.; Sudarshan, E.C.G. (Center for Particle Theory, University of Texas at Austin, Austin, Texas 78712). *Physical Review Letters;* 60: No. 6, 481-483(8 Feb 1988).

We investigate the problem of inequivalent quantizations of a physical system with multiply connected configuration space X. For scalar quantum theory on X we show that state vectors must be single valued if and only if the first homology group $H_1(X)$ is trivial, or equivalently the fundamental group $\pi_1(X)$ is perfect. The θ structure of quantum gauge and gravitational theories is discussed in light of this result.

16748 P-adic string N-point function. Frampton, P.H.; Okada, Y. (Institute of Field Physics, Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27514). *Physical Review Letters;* 60: No. 6, 484-486(8 Feb 1988).

The N-point functions for the p-adic version of the bosonic open-string theory are derived and discussed. The cases N = 5 and 6 are explicitly calculated, and lead to simple (factorizable) formulas from which the general N case can be formulated.

16749 Virasoro algebras with central charge c>1. Bagger, J.; Nemeschansky, D.; Yankielowicz, S. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). *Physical Review Letters;* 60: No. 5, 389-392(1 Feb 1988).

We provide evidence for a new unitary series of conformal field theories, labeled by integers M and N. For N = 1,2 they reproduce the unitary conformal and superconformal series of minimal models. For higher N, they correspond to models with c>1, generated by new nonlocal currents of spin (N+4)/(N+2). We use a generalization of the Feigin-Fuchs construction to find the currents and the primary fields of the new algebras.

16750 Are there any superstrings in eleven dimensions?. Curtright, T. (Department of Physics, Yale University, New Haven, Connecticut 06511-8167). *Physical Review Letters;* 60: No. 5, 393-396(1 Feb 1988).

Covariant actions are proposed for classical superstrings immersed in eleven space-time dimensions by construction of simple Chern-Simons terms. Local world-sheet variables are used which are space-time vectors, Majorana spinors, and antisymmetric tensors.

16751 New exact solutions for the purely cubic bosonic string field theory. Horowitz, G.T.; Morrow-Jones, J.; Martin, S.P.; Woodard, R.P. (Department of Physics, University of California, Santa Barbara, Santa Barbara, California 93106). *Physical Review Letters;* 60: No. 4, 261-264(25 Jan 1988).

A procedure is described for obtaining new exact solutions for the purely cubic form of Witten's bosonic string field theory. These solutions do not correspond to conformally invariant σ models. Some of them have no tachyons in their spectrum of linearized fluctuations (but may have negative-norm states). Others make no reference to a space-time metric.

16752 Quark loops matter. Pennington, M.R. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* 60: No. 4, 267-270(25 Jan 1988). Contract AC02-76CH00016.

Studies of the Schwinger-Dyson equation for the gluon propagator in the pure gauge sector have shown it to be strongly enhanced at low momenta. This enhancement in turn generates a severe suppression of the fermion propagator for massless quarks at the same low momenta, killing the pole at p = 0. Here we compute how loops of such quarks affect the gluon propagator and find they reduce the gluon's infrared enhancement by an amount out of proportion to their relative insignificance in the perturbative short-distance regime, indicating their unquenchable importance.

16753 High-energy unitarity of gravitation and strings. Muzinich, I.J.; Soldate, M. (Institute for Theoretical Physics, University of California, Santa Barbara, California 93106). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 2, 359-367(15 Jan 1988).

It is known that the behavior of a four-point string amplitude at large center-of-mass energy $\sqrt{s}$ and fixed momentum transfer $q = \sqrt{-t}$ is not perturbative. We study this region of phase space by summing multiple Reggeized graviton exchange in the eikonal approximation in D space-time dimensions. It is argued that the eikonal sum is at least representative of the summation of the leading powers of s in a string theory. The masslessness and high spin of the (Reggeized) graviton determine the character of the result. For $\kappa^2 sq/sup$ D-4/approx. <1 (κ is the gravitational coupling), the eikonal amplitude is dominated by single Reggeized graviton exchange. The amplitude in the region $\kappa^2 sq/sup$ D-4/>>1 is quite nonperturbative in character: simple Regge behavior and the Froissart bound are violated, and the amplitude does not satisfy a fixed-momentum-transfer dispersion relation. Although order by order the amplitude exhibits in q^2 the exponential decrease of Regge behavior, the final amplitude has only power-law falloff dependent on the number of space-time dimensions but independent of the Regge slope. The unitarity of the partial-wave projections of the eikonal amplitude is also studied. It is demonstrated that for $D \geq 4$ noncompact dimensions, the partial-wave amplitudes are bounded as $s \to \infty$ only for large values of angular momentum, lapprox. $> x_0 \sqrt{s}$, where x_0 is the dominant value of the impact parameter.

16754 Heterotic string on the simplest Calabi-Yau manifold and its orbifold limits. Walton, M.A. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 2, 377-390(15 Jan 1988). Contract AC03-76SF00515.

We study the heterotic string on the simplest (nontrivial) Calabi-Yau manifold K3 and its orbifold limits. We set the background gauge connection equal to the spin connection. The massless spectrum of the field theory that is the low-energy limit of the $E_8 x E_8$ string is derived on K3. Some terms in the effective Lagrangian for the massless modes are shown to be determined by the topology of K3. Several orbifold limits of K3 are described as T^4/Z/sub I/, after the singular points are removed and replaced by well-behaved spaces. Massless spectra of the full string theory on these orbifolds are obtained. Orbifold and manifold results are compared. Knowing how to blow up the orbifolds determines much of the full string massless spectrum, including information about the spectra of the individual twisted sectors.

16755 Finite-temperature effects on the Gaussian effective potential. Hajj, G.A.; Stevenson, P.M. (T. W. Bonner Laboratories, Physics Department, Rice University, Houston, Texas 77251-1892). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 2, 413-420(15 Jan 1988).

We derive the finite-temperature Gaussian effective potential (FTGEP) from first principles, resolving some confusions arising in earlier treatments. The advantages of the FTGEP approach over the conventional loop expansion, even for high temperatures, are illustrated in a quantum-mechanical example. Results are presented for phi^6 theory in two and three dimensions and for the "autonomous" version of λphi^4 theory in four dimensions.

16756 Overrelaxation algorithms for lattice field theories. Adler, S.L. (Institute for Scientific Interchange, Villa Gualino-Viale Settimio Severo 65, 10131 Torino, Italy). *Physical Review* [*Section*] *D: Particles and Fields;* 37: No. 2, 458-471(15 Jan 1988).

We study overrelaxation algorithms for the thermalization of lattice field theories with multiquadratic and more general actions. Overrelaxation algorithms are one-parameter generalizations of the heat-bath algorithm which satisfy the detailed-balance condition; the parameter is the relaxation parameter ω, $0 < \omega < 2$, with $\omega = 1$ corresponding to the heat bath. First, we show that the $\omega \to 0$ (extreme underrelaxation) limit of the overrelaxation algorithm is equivalent to the Langevin equation approach. We analyze the thermalization of a free-field action, and show that for $\omega \sim 2$ an overrelaxed Gauss-Seidel algorithm yields a critical slowing down which is independent of wavelength, and has a correlation time which is a factor N smaller than that for an unaccelerated Jacobi iteration, with N the linear dimension of the lattice in lattice units. For a general nonmultiquadratic action, we give a generalized overrelaxation algorithm which satisfies detailed balance with respect to an effective action which is explicitly computable in terms of the original action. In the case of SU(n) lattice gauge theory we use this construction to formulate an overrelaxed algorithm which has exact lattice gauge invariance, and which satisfies detailed balance with respect to an effective action differing from the Wilson action only by terms of relative order a^2 in the continuum limit, with a the lattice spacing.

16757 **Supercomputing the effective action.** Kuti, J.; Shen, Y. (Department of Physics, University of California at San Diego, La Jolla, California 92093). *Physical Review Letters;* **60**: No. 2, 85-88(11 Jan 1988).

We describe a new method for large-scale computer simulation of the effective action in lattice field theories. As a first application, the scalar phi^4 model with spontaneous symmetry breaking is studied, and the renormalization of physical parameters is calculated from the effective action. Mean-field scaling behavior with calculable logarithmic scaling corrections at the trivial Gaussian fixed point (vanishing renormalized coupling) is supported by our results. Applications to the electroweak theory are outlined and a bound on the Higgs-boson mass is estimated.

16758 **From QCD to the low-energy effective action through composite fields: Goldstone's theorem and f/sub π/.** McKay, D.W.; Munczek, H.J.; Young, B. (Department of Physics and Astronomy, The University of Kansas, Lawrence, Kansas 66045). *Physical Review [Section] D: Particles and Fields;* **37**: No. 1, 195-203(1 Jan 1988).

We elaborate upon a formal derivation from QCD of a composite-field (bilocal) effective chiral Lagrangian which we presented in a previous work. We give here a detailed treatment of the transition to the local form of the chiral Lagrangian in the low-energy limit, when chiral symmetry is spontaneously broken. We find an explicit form of the Goldstone-boson mode wave function and use it to derive expressions for the pion decay constant in terms of the quark dynamical mass Σ by two different methods. Using several models for Σ appropriate to QCD and one appropriate to technicolor, we compare the values given by our two different f/sub π/ expressions with each other and with the values for f/sub π/ given by an expression due to Pagels and Stokar. We find good agreement among the various methods of calculating f/sub π/, and the agreement with the experimental value is satisfactory for a condensate mass scale in the range 0.5—1.0 GeV.

16759 **Why do the known left-handed fermions have weak isospin 1/2? A possible lattice gauge theory explanation.** Lee, I.H.; Shrock, R.E. (Brookhaven National Lab., Upton, NY, USA. Physics Dept.; State Univ. of New York, Stony Brook, USA. Inst. for Theoretical Physics). *Physics Letters [Section] B;* **196**: No. 1, 82-86(24 Sep 1987). Contract AC02-76CH00016.

We suggest a possible explanation, based on properties of the (zero-temperature) chiral transition in lattice gauge-Higgs theories, for why the known left-handed fermions have weak isospin 1/2.

16760 **Theorems of perturbative QCD.** Collins, J.C.; Soper, D.E. (Department of Physics, Illinois Institute of Technology, Chicago, Illinois 60616; Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Annual Review of Nuclear Science;* **37**: No. 1, 383-409(1987).

A review of perturbative QCD results, particularly factorization theorems, from the literature "for which there is a statement of the result at all orders of perturbation theory and a reasonable approximation to a proof" is presented. (AIP)

65 PHYSICS II

16761 **(IPNO—1986) IPN Annual report 1986.** (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 139p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751394/JAW.

This progress report concerns, for physics, the period between october 85 and september 86, and for technical activities, the period between october 84 and september 86.

16762 **(LYCEN—8601) [High Energy and Nuclear Physics]. Progress report 1985.** (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). 1986. 130p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751421/JAW.

This progress report of the nuclear physics institute includes five basic subjects: theoretical physics, high energy and intermediate energy physics, nuclear physics, combined research physics and instrumentation (microelectronics, imaging, multidetectors, scintillators,...).

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 16477

16763 **(CEA-CONF—9072) Polarized electrons.** Duclos, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Jun 1987. 7p. (In French). (CEA-DPH-N-S—2466B; CONF-8706251—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751350/JAW.

From Workshop on intermediate energies; Grenoble, France (3 Jun 1987).

This article reviews all the possible uses of polarized electrons: as lepton probes, for polarization measurement in electron-nucleus scattering; in polarized electron sources; in beams with all the related problems of polarized beams; in reaction for parity violation measurement; in scattering for nucleon physics study.

16764 **(EFI—906(37)-86) (e,e') experiment with separation of contributions of longitudinal and transverse components of cross section in a range of E>1 GeV.** Mkrtchyan, G.G.; Troshenkova, I.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700165/JAW.

Some features of (e, e') experiment of the separation of contributions of longitudinally and transversely polarized photons in the range of imitial energies $E_0>1$ GeV are discussed. The practical realization of such investigations on the ErFI accelerator is considered. 7 references, 4 figures.

16765 **(GSI—87-9) Report of the expert committee 'Nuclear Physics and Heavy Ion Research' 1983-1985.** (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Apr 1987. 38p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751495/JAW.

In this report the results of heavy ion research in the projects sponsored by the Federal Minister for Research and Technology of the Federal Republic of Germany are surveyed. These concern the study of high-spin states, the production of superheavy and very neutron-deficient nuclei by heavy ion fusion reactions, the study of deep inelastic heavy ion reactions, intermediate energy heavy ion reactions, the production of a quark-gluon plasma in relativistic heavy ion reactions, and the positron production in ion collisions. Furthermore the heavy ion facilities in the Federal Republic of Germany are briefly listed. (HSI).

16766 **(HMI—437) Heavy ion physics at the VICKSI accelerator. A selection of research reports of external research groups.** (Hahn-Meitner-Institut Berlin G.m.b.H. (Germany, F.R.). Bereich Kern- und Strahlenphysik). 1987. 105p. (In German and English). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751499/JAW.

This report contains a selection of papers concerning work performed at VICKSI by external research groups together with the program of the scientific symposium occasionally to the opening of the tandem. The articles concern high-spin spectroscopy with OSIRIS, alpha and beta decay studies of neutron-deficient isotopes of tantalum and application for mass determination at the proton-drip line, rigid rotation versus shape coexistence in the N=Z=36 region, dissipation of linear momentum and energy in fusion-like reactions, orientation of the nuclear spin in heavy ion collisions at VICKSI energies, extreme cases of the local magnetism, and most deep implantations in semiconductor materials and structures. See hints under the relevant topics. (HSI).

16767 (IFVE-OEF—86-56) High Pperpendicular deuteron and antideuteron production in p-p and p-A collisions at 70 GeV. Abramov, V.V.; Baldin, B.Yu.; Buzulutskov, A.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700193/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

Results on the invariant cross section productions of deuterons and antideuterons for transverse momenta from 0.46 to 3.89 GeV/c in pp, pBe, pCu, and pPb collisions at 70 GeV are presented. There are also obtained the cross section ratios σ/sub d//σ/sub p/ and σ/sub d/-bar/σ/sub p/-bar as well as the tritium yield. The analysis shows that deuteron, antideuteron and tritium production at high Pperpendicular is well described by a model of secondary nucleon fusion with a small relative momentum. The results are compared with data obtained at higher energies. 28 references, 8 figures, 4 tables.

16768 (INIS-GB—50) Nuclear physics annual report 1986. (Manchester Univ. (UK). Schuster Lab.). 1986. 107p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750894/JAW.

The paper is the annual report of Manchester University Nuclear Physics Group, 1985/6. The bulk of the work has been carried out at the Nuclear Structure Facility, often in collaboration with other groups. The research programme topics include: high spin states, nuclei far from stability, reactions and fission, spectroscopy and related subjects, and technical developments. The experiments associated with these topics are described, together with the results of the investigations.

16769 (INIS-GB—58) Report of the Science and Engineering Research Council for the year 1985-1986. (Science and Engineering Research Council, Swindon (UK)). 13 Nov 1986. 108p. Science and Engineering Research Council, Swindon (UK); Price $5.00.

The paper presents the report of the Science and Engineering Research Council (SERC), United Kingdom, 1985/6. Included in the report are : review articles, highlights of the year, and the reports of the four boards i.e. i) Astronomy, Space and Radio, ii) Engineering, iii) Nuclear Physics, and iv) Science. The latter reports contain studies on solar system science, particle physics and nuclear structure. The review articles describe various recent major advances in which SERC has been involved, including : Comet Halley, recent advances in medical engineering, neutron scattering, ultrafast time-resolved spectroscopy of semiconductors, experiments at PETRA, probing the nucleus with tagged photons, and Cygnus X-3. (U.K.).

16770 (INIS-SU—431, pp 395) Yields of products with Z=3-8 in the /sup 14/N reactions with C,Al and Ca nuclei at 150 MeV. Akushev, V.E.; Goryunov, O.Yu.; Koshchij, E.I. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16771 (JAERI-M—87-122) Evaluation of half-lives and average decay energies for short-lived fission product nuclides. Tachibana, Takahiro; Yamada, Masami. (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 59p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751974/JAW.

β-decay half-lives T/sub 1/2/, average β-energies E-bar/sub β/, and average γ-energies E-bar/sub γ/, which are essential for the decay heat, are calculated with use of an improved gross theory of β-decay. First, the improvement of the gross theory is explained, and then T/sub 1/2/, E-bar/sub β/, and E-bar/sub γ/ are tabulated for β/sup -/-decay nuclides with 26 < Z(proton number) < 65 and N(neutron number) < (147/92)Z + 6 except for those with small Q-value. The β-decay Q-values used in this calculation are obtained from the Wapstra-Audi mass evaluation and a mass formula newly constructed by Tachibana et al. Figures are given to indicate how the results depend on the parameters in the model.

16772 (JINR—R-10-86-812) Method of scarcely-probable event separation based on Smirnov-Cramer-Mises accordance agreement criterion. Zrelov, P.V.; Ivanov, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701179/JAW.

The method for small-probable event separation based on the Smirnov-Cramer-Mises accordance criterion is suggested for the case when distributions analysed are simulteneous measurements of the same random variables by different instruments. Application of this method for analysing mass spectra of secondray particles produced by high deuteron fragmentation on target-nuclei allowed one to separarte efficiently rare events in the processes with secondary deuteron production. It is shown that in the case of small size samples the significance level corresponding to selected critical level is to be determined using cumulative function tables for specific sample since the asymptotic function used for these purposes can lead to the difficulties in separated event classification due to an error in significance level determination. 11 refs.; 5 figs.

16773 (LYCEN—8702, pp c.7.1-c.7.11) Review on recent experiments on double beta decay. Leccia, F. (Bordeaux-1 Univ., 33 - Gradignan, France. Centre d'Etudes Nucleaires). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Double beta decay is considered as a very sensitive test on lepton number non conservation, and beyond, on properties of the neutrino. After some brief theoretical considerations, we review recent experiments on $2\beta(2\nu)$and $2\beta(0\nu)$ decays.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 15879, 16927, 17083

16774 (DOE/ER/02853—34) Nuclear structure studies by the scattering of medium-energy electrons: Final report for the period January 2, 1976-December 31, 1987. Peterson, G.A. (Massachusetts Univ., Amherst (USA)). Dec 1987. Contract AC02-76ER02853. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004916/JAW.

In 1976 the University of Massachusetts was in the process of completing nuclear structure investigations by means of electron scattering at the US National Bureau of Standards. In late 1977 it finished the construction of a magnetic deflection system for 180 deg electron scattering for use at the MIT-Bates Linear Accelerator Center. The results obtained by using this apparatus were used in obtaining information about nuclear convection, spin, and meson exchange currents. A variety of studies over a wide range of nuclear species has been and is still being carried out by these means. In 1984 experiments at much higher momentum transfers were begun at the Stanford Linear Accelerator Center. Especially short range nuclear phenomena were explored by using the Stanford facilities. For example, the short range details of the wave function of the simplest nucleus, the deuteron, were investigated by means of elastic magnetic scattering of electrons. Current planning is underway to utilize the PEP storage ring at Stanford for internal gas jet target studies. The results of large basis shell calculations have been used in interpreting the experimental results. Theoretical studies of hypernuclei, of relativistic nucleon-nucleon interactions, of weak interactions, and of hypernuclei are continuing.

16775 (DOE/ER/40048—45-N7) Pion scattering and the nuclear pionic content. Jung, Hong; Miller, G.A. (Washington Univ., Seattle (USA). Dept. of Physics). 1987. Contract AC06-81ER40048. 10p. (CONF-8708102—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004230/JAW.

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

A new method for relating the pion nucleus optical potential to the density of pions in the nuclear medium is discussed. 6 refs., 5 figs.

16776 (LYCEN—8702, pp c.11.1-c.11.14) **Production, identification and spectroscopy of exotic nuclei on the "Lise" line at GANIL.** Pougheon, F. (Paris-11 Univ., 91 - Orsay, France. Institut de Physique Nucleaire). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Very exotic nuclei have been produced by fragmentation of the projectile at intermediate energy at GANIL. They have been identified through time of flight and ΔE - E measurements after a magnetic separation with the LISE spectrometer. The neutron drip line up to Z = 7 and the proton drip line up to Z = 29 was mapped within these experiments. The β-γ, β-n and β-p spectroscopy of these nuclei has been undertaken.

16777 **(UCRL—97229) Monopole strength as a probe of nuclear shape mixing.** Meyer, R.A. (Lawrence Livermore National Lab., CA (USA)). 17 Aug 1987. Contract W-7405-ENG-48. 23p. (CONF-8708123—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003299/JAW.

From International conference on nuclear structure through static and dynamic moments; Melbourne, Australia (25 Aug 1987).

The monopole strength, MS, within a single set of nuclear shape excitations is compared with the MS between different shapes. After misconceptions are pointed out concerning the spin dependence of B(E2) values, MS properties are juxtaposed with gamma-ray and beta-decay properties of ^{70}Se, ^{96}Zr, ^{102}Pd, and the N = 60 isotones to illustrate the utility of combined investigations and evidence is given for the observation of a two-phonon octupole multiplet. Finally, consideration is given to the dominance of the $^3S_1$ force in producing deformation in the N > 50 1g nuclei. 23 refs., 4 figs.

16778 **Highlights of the workshop, "physics with light mesons, eta, rho, ω, etc." and "The second international workshop in πN physics".** Nefkens, B.M.K. (UCLA Physics Department, Los Angeles, CA 90024). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 179-193(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

After more than a decade of very intense studies of the interactions of pions in nuclear matter time has come to consider using new experimental tools. Other quark configurations different than the pi meson need to be investigated. To lay the groundwork for this, a one day workshop was held at LAMPF on the subject "Physics with Light Mesons, eta, rho, ω, etc.," on August 14, 1978. The program of the meeting is shown in Table I. The objectives of the workshop were to discuss the properties, production processes, propagation in matter, and the many disintegration modes of light mesons. Some of the topics discussed are sketched below.

16779 **Pionic atom anomaly and low-energy pion elastic scattering.** Seki, R. (Department of Physics, California State University, Northridge, CA 91330). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 233-246(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

The present status of the pionic atom anomaly is discussed with emphasis on clarification of its phenomenological characteristics. Anomalous effects in low-energy elastic pion scattering are also examined from a phenomenological point of view.

16780 **Radiative pion capture as an alternative to pion photoproduction.** Miller, J. (Boston University, Boston, Massachusetts 02215). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 438-453(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

In this talk I will look into the possible merits of radiative pion capture on nucleons and nuclei as a complement to pion photoproduction. I will be mainly concerned with energies from the pion production threshold through Delta resonance energies, or from pion energies m/sub π/ = 139.6 MeV to the peak at about 330 MeV, and perhaps 50 MeV beyond. It turns out there are a number of crucial measurements that can be done.

16781 **Nuclear effects in deep inelastic lepton scattering.** Berger, E.L.; Coester, F. (Argonne National Laboratory, Argonne, Illinois 60439). *Annual Review of Nuclear Science;* **37**: No. 1, 463-491(1987). Contract W-31-109-ENG-38.

A review of the accumulated data from deep inelastic lepton scattering which has studied the EMC effect is given. Analysis of the data in terms of QCD confinement and the standard meson exchange model is given. (AIP)

16782 **Nuclear fragmentation in proton- and heavy-ion induced reactions.** Lynch, W.G. (National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). *Annual Review of Nuclear Science;* **37**: No. 1, 493-535(1987).

Experimental and theoretical results of spallation processes in proton and heavy ion reactions are reviewed. Fragmentation models, fragmentation at relativistic and nonrelativistic energies are the general topics which are covered in this review. (AIP)

16783 **Role of giant resonances in heavy-ion radiative capture.** Sandorfi, A.M. (Physics Department, Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 647-659(15 Jan 1985). (CONF-840906—). Contract AC02-76CH00016.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

6512 Nuclear Properties And Reactions, A=1-5, Experimental

16784 **(CEA-CONF—9028) Measurement at Saturne, with a free polarized neutron beam, of cross sections and spin observables for neutron-proton system.** Terrien, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie). Apr 1987. 20p. (CEA-DPH-N-S—2449B; CONF-870413—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751341/JAW.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

Experiments currently done at Saturne (Saclay) with a free polarized neutron beam are described. These are measurements for the n-p system of elastic and inelastic cross sections and analysing powers and of Δσ/sub /T and Δσ/sub L/.

16785 **(CEA-CONF—9094) Electron scattering and few-nucleon systems.** Frois, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Jun 1987. 31p. (CEA-DPH-N-S—2471; CONF-8706166—). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88751842/JAW.

From International symposium on medium energy physics; Beijing, China (23 Jun 1987).

In this talk I will briefly review the present experimental situation on electron scattering and few-nucleon systems.

16786 **(CEA-CONF—9096) Two and three-nucleon form factors.** Schuhl, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Jul 1987. 13p. (CEA-DPH-N-S—2468; CONF-8706232—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751714/JAW.

From International symposium on modern developments in nuclear physics; Novosibirsk, USSR (27 Jun 1987).

The two and three-nucleon form factors play an important role in the understanding of the fundamental properties of the nucleon-nucleon interaction. Since for these systems the Schrodinger equation can be exactly solved, they are good tool to study the limits of the pure nucleonic description of nuclei. The recent experimental results impose to take into account the non-nucleonic degrees of freedom, which are the Meson Exchange Current (MEC) contribution.

16787 (CONF-870413—18) Charge-symmetry nonconservation in pi$^+$ and pi$^-$ elastic scattering on ^{3}H and ^{3}He. Pillai, C.; Barlow, D.B.; Berman, B.L.; Briscoe, W.J.; Mokhtari, A.; Nefkens, B.M.K.; Petrov, A.M.; Sadler, M.E. (California Univ., Los Angeles (USA). Dept. of Physics; George Washington Univ., Washington, DC (USA). Dept. of Physics; Abilene Christian Univ., TX (USA). Dept. of Physics). 1987. Contract AS03-81ER40021;AS05-81ER40036;FG05-86ER40285. 15p. NTIS, PC A03. Order Number DE88003824/JAW.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

Extensive new data on the superratio R are reported for π^+ and π^- elastic scattering on ^{3}H and ^{3}He at T/sub π/ = 142, 180, and 220 MeV at θ/sub π/(lab) from 40° to 110°. In all cases R > 1, which cannot be explained by electromagnetic effect and therefore indicates nonconservation of nuclear charge symmetry. The charge-symmetric ratios r_1' and r_2' also have been obtained. It is found that $r_1' \simeq 1$ and $r_2' > 1$ in all cases. 20 refs., 3 figs.

16788 (INIS-SU—428, pp 5-16) Annihilation of stopping antiprotons in /sup 4/He and /sup 3/He. Batusov, Yu.A.; Bunyatov, S.A.; Falomkin, I.V. 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780044/JAW. (JINR-N—1[21]-87).

In JINR rapid communications. Collection.

Annihilation of antiprotons stopping in /sup 4/He and /sup 3/He has been studied at the LEAR facility of CERN using a streamer chamber in a magnetic field. Measured are charged particle multiplicities. The ratio is determined between the annihilation probabilities on the neutron and the proton bound in the nucleus; this ratio has turned out to be nearly two times smaller than the corresponding value measured in the case of antiproton annihilation in deuterium. The causes of this discrepancy are discussed. 18 refs.; 3 figs.; 4 tabs.

16789 (INIS-SU—431, pp 321) Elastic scattering of 29.5 MeV deuterons on /sup 3/He polarized target. Yasnogorodskij, A.M.; Ostashko, V.V.; Urin, V.N.; Nenakhov, A.N. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16790 (INIS-SU—431, pp 322) Phase analysis of the /sup 4/He+/sup 3/He elastic scattering at energies above 25 MeV in cms. Ostashko, V.V.; Yasnogorodskij, A.M. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16791 (INIS-SU—431, pp 323) Measurement and phase analysis of differential cross sections of the /sup 4/He(α,α)/sup 4/He scattering at energies of 56-95 MeV. Nemets, O.F.; Ostashko, V.V.; Urin, V.N.; Yasnogorodskij, A.M. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16792 (IPNO-DRE—84-42) Are the Narrow structures recently seen in T = 1, B = 2 missing mass spectra, dibaryons. Tatischeff, B. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751614/JAW.

The structures observed in recent missing mass experiments /sup 3/He(p,d)X and p(/sup 3/He,d)X are discussed and shown to agree to a high accuracy with a rotational scheme M = M/sub 0/ + M/sub 1/J(J + 1). An explanation is suggested as to why these structures have not been observed in some other experiments.

16793 (IPNO-DRE—86-26) Further evidence concerning narrow isovector nonstrange dibaryons. Tatischeff, B.; Comets, M.P.; Le Bornec, Y. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1986. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751615/JAW.

The missing-mass spectra for the /sup 3/He(p,d)X reaction (B/sub x/ = 2, T/sub x/ = 1) have been measured at T/sub p/ = 1.2 GeV for θ/sub d/ = 33/sup 0/. Narrow structures have been observed at M/sub x/ = 2.122, 2.198 and possibly 2.233 GeV with FWHM respectively equal to 5.2, 8.1 and 13 MeV. These results which were obtained in new kinematical conditions, confirm our previous data.

16794 (IPNO-DRE—87-03) Delta excitation by charge exchange heavy ion reaction. Roy-Stephan, M.; Bachelier, D.; Boyard, J.L. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 12p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751618/JAW.

First results with heavy ion charge exchange results are given. /sup 12/C, /sup 14/N, /sup 16/O, /sup 20/N beams of 900 MeV by nucleon are used. Δ excitation was shown up. Its intensity depends on projectile-ejectile couple. In a nucleus, target nucleus nucleons have an attractive effect on the Δ produced by charge exchange, with heavy ions as much as with light ions.

16795 (IPNO-DRE—87-21) Recent searches for S = -1 strange dibaryons. Frascaria, R.; Siebert, R. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). May 1987. 10p. (CONF-870520—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751622/JAW.

From Workshop on intermediate nuclear physics; Miramare, Italy (18 May 1987).

A new p-p -> K/sup +/X experiment has been performed at the Saturn National Laboratory to study through final state interaction λ-p and σ-N in a large range of momentum transfer and missing mass. After some recalls on recent searches on strange dibaryons we present here preliminary calculations of the p-p -> K/sup +/ (λ)p differential cross section done within the one kaon exchange mechanism with (λ)-p final state interaction.

16796 Measurement of charged pion asymmetries in scattering of polarized electrons from polarized ^{3}He. Milner, R.G.; Donnelly, T.W. (W. K. Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, California 91125). *Physical Review [Section] C: Nuclear Physics;* 37: No. 2, 870-872(Feb 1988).

It is proposed that a measurement of the ratio of the charged pion asymmetries for the Δ(1232) resonance with a polarized electron beam on a polarized ^{3}He target provides a sensitive test of the presence of Δ components in the ground state of ^{3}He. In the absence of final-state interactions and nonresonant contributions, it is estimated in a simple quasielastic scattering picture that the ratio of charged pion asymmetries would change by a factor of 2 for a 2% probability to find a Δ in the ground state of ^{3}He.

16797 Isobaric-analog-state transitions in pion charge-exchange reactions above the Δ(1232) resonance. Baer, H.W.; Bergmann, A.G.; Bowman, J.D.; Irom, F.; Leitch, M.J.; Seftor, C.J.; Rokni, S.H.; Alster, J.; Piasetzky, E.; Clausen, B.L.; and others. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 67-78(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

Forward-angle differential cross sections for the (π^+, π^0) reaction to isobaric analog states were measured at 300, 425, 500, and 550 MeV on targets ranging in mass from ^{7}Li to /sup 208/Pb. The 0° cross sections are found to rise markedly between 300 and 425 MeV, contrary to the behavior of the free πN process. The mass and energy dependence of the cross sections at the higher energies are discussed within the framework of the Glauber model.

16798 Systematics of inclusive double charge exchange. Gram, P.A.M. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 79-99(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

Results of extensive observation of inclusive double charge exchange in ten nuclei ranging in A from 3 to 208 are presented. Possible mechanisms for the reaction suggested by the systematics of these data are discussed.

16799 (π, eta) and (π^+, K^+) reactions in nuclei. Peng, J.C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 160-178(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

The subject of meson productions in nuclei, a new direction in pion-nucleus physics, is discussed. Recent experimental results at LAMPF and AGS on the (π, eta) and (π^+, K^+) reactions in nuclei are presented.

16800 Studies of pion absorption at SIN. Kyle, G.S. (Department of Physics, New Mexico State University, Las Cruces, NM 88003). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 289-307(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

Some recent experiments and new initiatives at the Swiss Institute for Nuclear Research (SIN) are described. These studies of pion-nucleus absorption demonstrate the importance of true multinucleon mechanisms and make clear the necessity for large acceptance detectors in pion physics. This has led to a new proposal there to build a detector (LADS) with nearly 4π sr coverage for studies of pion-nucleus reactions.

16801 /sup 2/H(d,γ)/sup 4/He reaction at low energy and the d-state admixture in /sup 4/He. Barnes, C.A.; Chang, K.H.; Donoghue, T.R.; Rolfs, C.; Kammeraad, J. (California Inst. of Tech., Pasadena, USA. W.K. Kellogg Radiation Lab.; Lawrence Livermore National Lab., CA, USA). *Physics Letters [Section] B;* **197**: No. 3, 315-319(29 Oct 1987). Contract W-7405-ENG-48.

The cross section and angular distribution of the /sup 2/H(d,γ)/sup 4/He reaction have been measured from E/sub CM/ = 50 to 500 keV. For E ≦ 200 keV, the observed near-constant cross-section S-factor and isotropy show that the dominant radiative capture amplitude is /sup 5/S/sub 2/ -> /sup 5/D/sub 0/, instead of the /sup 1/D/sub 2/ -> /sup 1/S/sub 0/ amplitude that dominates at higher energies. Thus the /sup 4/He D-state admixture can be determined from the low-energy cross section alone. Values obtained from different models range up to 14%. As the new astrophysical S-factor is 32 times larger than previously estimated, it will likely affect inhomogeneous big-bang nucleosynthesis models.

16802 Radiative capture in few nucleon systems. Weller, H.R. (Triangle Universities Nuclear Laboratory and Duke University, Durham, North Carolina 27706). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 470-482(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

This talk will constitute an attempt to report recent low energy capture experiments which are providing new information on small components of the nuclear wavefunctions in the 2, 3 and 4 body nuclear systems. Recent polarized n-capture data on ^{1}H which address the question of whether these data require meson exchange current effects will be presented. Several new results will be described in the case of the three body problem; new polarized proton capture data, analyzed with D-state effects included, yield new and lower E2 strengths which are in reasonable agreement with inverse reaction measurements and calculations. Polarized d-arrow-right on p and p-arrow-right on d data will be presented which exhibit the sensitivity of these measurements to the presence of s = 3/2 M1 strength just above threshold in ^{3}He. And tensor analyzing power measurements of the ^{1}H(d,γ) ^{3}He reaction which are sensitive to D-state effects in He will be described and compared to calculations which employ recent Faddeev generated wavefunctions. Finally, new data on the tensor analyzing powers for the ^{3}H(d,γ) ^{4}He reaction which provide new information on the D-state of ^{4}He will be described. A simple model calculation will be used to demonstrate that the observed isotropic T/sub 20/(θ) of -0.22 +- 0.014 is consistent with a 4.8% D-state admixture in the two deuteron wavefunction used to described ^{4}He.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

16803 (CENBG—8613) Beta decay of twelve light neutron-rich isotopes from /sup 17/C to /sup 40/S. Dufour, J.P.; Del Moral, R.; Fleury, A.; Hubert, F.; Jean, D.; Pravikoff, M.S.; Delagrange, H.; Geissel, H.; Schmidt, K.H. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). Jul 1986. 6p. (CONF-860741—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751362/JAW.

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

The results reported here have been obtained with an /sup 40/ Argon beam on a Be target. The separated nuclei were implanted in a catcher foil placed in between a thin scintillator detecting the betas and a high volume Ge detector; only gammas in coincidence with betas were recorded. Results for the gamma energies and the half-lives of the observed isotopes are given.

16804 (CRN-PN—86-35) Contribution to nuclear structure study by precise measurement of mass defects and by systematic analysis of some macroscopic properties. Antony, M. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Jul 1986. 192p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751375/JAW.

This work is presented in three chapters whose contents are drawn from published works. Mass defects of the nuclei /sup 13/B, /sup 19/F, /sup 20/O, /sup 25/Na, /sup 29/Al, /sup 32/Si, /sup 32/S and /sup 39/Cl through (t,p) and (p,γ) reactions have been measured with more precision than the hitherto known values. Systematics of the isobaric multiplet mass equation and of Coulomb displacement energies have been employed to predict masses and excitation energies of analogue states of the proton rich nuclei. Shell and sub-shell closures are deduced from the trends of the energy pattern of low-lying levels of even-even nuclei. Possible sub-shell closures at Z=64 and N=56,64 are suggested. Lifetimes of certain excited levels of /sup 14/N have been measured by Doppler Shift Attenuation Method. Periods of /sup 82/Br, /sup 128/I, /sup 139/Ba and /sup 161/Tb were obtained by thermal neutron capture.

16805 (DOE/ER/02853—33) **Nuclear structure studies by the scattering of medium-energy electrons: Progress report, September 1, 1986-June 30, 1987.** Teterson, G.A.; Hicks, R.S.; Dubach, J.F.; Miskimen, R.A. (Massachusetts Univ., Amherst (USA)). Jun 1987. Contract AC02-76ER02853. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003803/JAW.

This paper discusses the experimental electron scattering studies at SLAC and Bates Accelerator Center. Some theoretical work on nucleon-nucleon interactions, electromagnetic interactions, weak interactions and nuclear structure are also discussed. (LSP)

16806 (DOE/ER/40146—T2) **[Medium high energy physics at Syracuse University: Technical progress report].** (Syracuse Univ., NY (USA)). 1987. Contract FG02-84ER40146. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003670/JAW.

The main effort of our group has been to perform an experiment at the MIT-Bates Linear Accelerator Center to measure the spin-dependence of elastic scattering from carbon. This year we have injected polarized electrons into the Bates Linac at intensities approaching the design value with acceptable lifetimes. We have also made a preliminary measurement of the parity-violating asymmetry with a sensitivity a few times that of expected effect. We are proceeding to improve this result by at least an order of magnitude. We are also a member of the collaboration which will measure the tensor polarization of deuterons scattered by electrons. Preliminary running of this experiment occurred this past year.

16807 (INIS-SU—431, pp 386) **On a possibility of the use of the (/sup 14/N, /sup 8/He) reaction for a study of neutron-deficient nuclei.** Artemov, K.P.; Golovkov, M.S.; Gol'dberg, V.Z.; Pankratov, V.V.; Rudakov, V.P.; Serikov, I.N.; Timofeev, V.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16808 (INIS-SU—431, pp 474) **Role of one-step transfers in the /sup 12/C(d,/sup 6/Li)/sup 8/Be reactions.** Goryunov, O.Yu.; Kadmenskij, S.G.; Koshchij, E.I.; Luk'yanovich, P.A.; Mashkarov, Yu.G.; Nemets, O.F.; Rudchik, A.t. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16809 (INIS-SU—431, pp 518) **Partial cross sections of π/sup +/- meson scattering on /sup 12/C,/sup 14/N,/sup 16/O nuclei with neutron emission.** Bojko, A.I.; Gismatullin, Yu.R.; Melent'ev, A.A.; Ostroumov, V.I.; Petukhov, A.M. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16810 (INIS-SU—431, pp 519) **60 MeV π/sup +/- meson scattering on light nuclei.** Gismatullin, Yu.R.; Kononykhin, A.V.; Melent'ev, A.A.; Petukhov, A.M. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16811 (INIS-SU—431, pp 271) **Two-particle channels of stopped pion absorption reactions by /sup 9/Be nuclei.** Gornov, M.G.; Gurov, Yu.B.; Morokhov, P.V.; Savel'ev, V.I.; Sergeev, F.M.; Chernyshev, B.A.; Shafigullin, P.P. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16812 (INIS-SU—431, pp 299) **Interaction of mean-energy protons with nucleons and clusters of lithium and beryllium nuclei.** Gajdaenko, S.A.; Kadkin, E.P.; Pasechnik, M.V.; Saltykov, L.S.; Fursa, A.D. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16813 (INIS-SU—431, pp 324) **Search for bremsstrahlung in the /sup 9/Be(α,α)/sup 9/Be reaction.** Kolalis, R.P.; Lazarev, V.V.; Sadkovskij, V.S.; Feofilov, G.A.; Khrisanfov, Yu.V.; Vinogradov, L.I.; Denisov, A.E. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16814 (INIS-SU—431, pp 327) **Investigation of the 39.6 MeV /sup 3/He ion elastic scattering on /sup 12,13,14,/C nuclei in the angle range of Θ/sub cms/=10 deg-175 deg.** Burtebaev, N.; Goncharov, S.A.; Dem'yanova, A.S.; Ivanov, G.N.; Lyashko, Yu.V.; Ogloblin, A.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16815 (INIS-SU—431, pp 328) **Observation of strong increase of cross section in the large angle range for the /sup 13,14/C(/sup 3/He,t) recharge reaction.** Burtebaev, N.; Goncharov, S.A.; Dem'yanova, A.S.; Ivanov, G.N.; Lyashko, Yu.V.; Ogloiin, A.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16816 (INIS-SU—431, pp 332) **Polarization of intermediate nuclei in the /sup 12/C(α,α')/sup 12/C/sup */(α)/sup 8/Be reaction at E/sub α/=27.2 MeV.** Kozyr', Yu.E. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16817 (INIS-SU—431, pp 349) **Measurement of excitation function using gaseous absorber at cyclotron beam.** Artemov, S.V.; Islamov, B.I.; Kadushkin, V.N. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16818 (INIS-SU—431, pp 391) **Study on a stability of multineutron systems in heavy ion reactions.** Belozerov, A.V.; Borcha, K.; Dlougy, Z.; Kalinin, A.M.; Nguen Khoaj T'yau; Penionzhkevich, Yu.Eh. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16819 (JINR-E—1-86-650) **High-statistics measurement of the nucleon structure function $F_2(x,Q^2)$ from deep inelastic muon-carbon scattering at high Q^2.** Benvenuti, A.C.; Bollini, D.; Bruni, G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700262/JAW.

Submitted to the 23. International conference on high energy physics, Berkeley (USA), 17-23 Jul 1986.

The results from a high statistics study of the nucleon structure function $F_2(x, Q^2)$ in the kinematic range $x \geq 0.25$ and $Q^2 \geq 25$ GeV^2 are presented. The analysis is based on 1.5×10^6 recon-

structed events recorded at beam energies of 120, 200 and 280 GeV. By comparing data taken at different beam energies, it is found that a ratio R=δ/sub L//δ/sub T/=0.015+-0.013 (stat.) +-0.026 (syst.) is independent of x in the range 0.25 ≦ x ≦ 0.7 and 50 GeV² ≦ Q² ≦ 150 GeV². The kinematic region of these data makes them well suited for quantitative tests of quantum chromodynamics (QCD). From a next-to-leading order nonsinglet fit, a QCD mass scale parameter Λ/sub M/-bar/sub S/-bar=225+-20 (stat.)/sub -60//sup +70/ (syst.) MeV is founded. 13 references.

16820 (LYCEN—8702, pp C.4.1-C.4.17) **Recent results in charge exchange reactions.** Gaarde, C. (Niels Bohr Institute, Copenhagen, Denmark). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Charge exchange reactions at intermediate energies are discussed. For (/sup 3/He,t) reactions a shift, changing with momentum transfer, of the quasielastic peak is observed relative to the electron scattering data. This shift is related to the shift of the Δ-peak in nuclei, also seen in (/sup 3/He,t) experiments. The (d,/sup 2/He) reaction with a tensor polarized beam is shown to be a very interesting probe of spin correlations in nuclei, but also of the spin structure of the Δ excitation. Results from charge exchange reactions with heavy ions are briefly discussed.

16821 (LYCEN—8702, pp S.8.1-S.8.10) **Light fragment production at small angles in nuclear collision.** Bastid, N.; Alard, J.P.; Arnold, J. (Clermont-Ferrand Univ., 63-Aubiere, France, LPC). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

The plastic wall associated with Diogene is used for analysis of light fragments emitted in Ne + nuclei collisions in the incident energy range 200 - 1000 MeV/u, in the angular range 0-6/sup 0/ lab. We observe a correlation between the multiplicities in the wall and in the central chamber, and we show that even for heavy targets the nuclear matter remains partially transparent.

16822 (LYCEN—8702, pp c.1.1-c.1.25) **Relativistic nucleus-nucleus collisions with diogene.** Augerat, J.; Alard, J.P.; Arnold, J. (Clermont-Ferrand Univ., 63 - Aubierre, France. L.P.C.). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Diogene, an electronic detector, has been built at the Saturne Synchrotron in Saclay; the trajectories of fragments emitted at large angles are recorded in a cylindrical Pictorial Drift Chamber (PDC) surrounding the target. The PDC is inside a 1-T magnetic field parallel to the beam axis. The forward angular range (0-6 degrees) is analysed by 48 time-of-flight scintillator telescopes that provide charge identification. Good identification has been obtained for both positive and negative pions and for hydrogen and helium isotopes. Multiplicities in Ne + A reactions up to 35 have been analysed, limited only by the current electronics. We report here PI/sup +/ and PI/sup -/ measurements for α + (C, Cu, Pb) reactions at 200, 400, 600 and 800 MeV/A: our results are compared to the CUGNON's intranuclear cascade predictions "filtered" by the detector and trigger acceptance. The pion and proton spectra are compared with a thermodynamical model. For the Ne + (C, NaF, Nb, Pb) reactions, two topics are presented and discussed: the correlations between two protons at 400 and 800 MeV/A have been measured, the extracted radii increase with multiplicity and with the size of the target; a reaction plane study has been performed using an event-by-event analysis.

16823 (TRI-PP—87-79) **Gamow-Teller strength functions from nucleon scattering experiments.** Haeusser, O. (Simon Fraser Univ., Burnaby, British Columbia (Canada); TRIUMF, Vancouver, British Columbia (Canada)). Oct 1987. 5p. (CONF-870970—12). NTIS (US Sales Only), PC A02. Order Number DE88900275/JAW.

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

The spin-isospin structure of nuclear excitations up to ~50 MeV has been studied using (n,p), (p,p') and (p,n) reactions at TRIUMF. At 200 to 400 MeV the L = 0 isovector spin-transfer component of the cross section is closely related to the Gamow-Teller strength function. Results are discussed which have implications for Gamow-Teller quenching in (sd) and (fp) shell nuclei, for the Ikeda sum rule, and for the importance of 2particle-2hole correlations in nuclear wavefunctions. 28 refs., 7 figs.

16824 (UCRL—97539) **Emission of γ rays from various materials pulsed with 14-MeV neutrons.** Goldberg, E.; Hansen, L.F.; Howerton, R.J.; Komoto, T.T.; Pohl, B.A. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 8p. (CONF-8710192—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003837/JAW.

From Nuclear explosives design physics conference; Los Alamos, NM, USA (19 Oct 1987).

We have performed a number of experiments at LLNL recently to investigate the leakage of gamma rays from spheres of selected materials pulsed centrally with 14-MeV neutrons. Such spectral information may be carefully compared to calculational results to validate the transport models, particularly the nuclear cross section data base. In the present case, the TART code and SANDYL codes are used to explicitly calculate the observable, the recoil electron spectrum. The materials studied were H_2O, ^6LiD, Be, C, ^{14}N, CF_2, Al, Si, Ti, Fe, Cu, Ta, W, Au, Pb, Th, and ^{238}U. Generally, agreement was good between experiment and calculation. However, for some, the calculations significantly underestimated or overestimated experiment. For oxygen (i.e., H_2O), the ENDL cross section set led to a sizeable calculational overestimate. Re-examination led to a large improvement. For tungsten, the calculated output was ~30% below experiment. A re-evaluation led to closer agreement. 16 refs., 10 figs., 1 tab.

16825 **Issues in hypernuclear physics.** Gal, A. (Racah Institute of Physics, The Hebrew University, Jerusalem 91904, Israel). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 144-159(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

Two issues in hypernuclear physics, highlighted by recent experiments at the Brookhaven AGS, are discussed: (i) the nature and systematics of Λ single-particle levels revealed in ($π^+$, K^+) spectra on several nuclear targets from ^{9}Be to /sup 89/Y, particularly for the 1 s/sub Λ/ ground-state configuration where Pauli repulsion effects arising from quark deconfinement have been conjectured; and (ii) the spin-isospin dependence of the nonmesonic weak decay ΛN → NN as extracted from partial decay rates measured for ^{5}/sub Λ/He and /sup 12//sub Λ/C, a dependence which has defied so far any explanation, perhaps due to its extreme sensitivity to short-range behavior. Additional issues bearing on future directions in hypernuclear physics, such as the spin dependence of the Λ-nuclear interaction, the interpretation of Σ-hypernuclear spectra and (strangeness) S = -2 physics, are only briefly mentioned.

16826 **Comparison of photoabsorption by /sup 16/O and /sup 18/O.** Sherman, N.K.; Davidson, W.F.; Raman, S.; Delbianco, W.; Kajrys, G. (National Research Council, Ottawa, Canada K1A 0R6). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 221-224(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

We are comparing the transmission of 3 to 38 MeV photons by /sup 16/O-water and /sup 18/O-water in order to measure the integral over the giant dipole resonance (GDR) of the photonuclear absorption cross section of /sup 16/O.

16827 "Fast neutron capture with a white neutron source". Wender, S.A.; Auchampaugh, G.F. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* 125: No. 1, 483-492(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

A system has been developed at the Los Alamos National Laboratory to measure gamma-rays following fast neutron reactions. The neutron beam is produced by bombarding a thick tantalum target with the 800 MeV proton beam from the LAMPF accelerator. Incident neutron energies, from 1 to over 200 MeV, are determined by their times of flight over a 7.6-m flight path. The gamma-rays are detected in five 7.6 x 7.6-cm cylindrical bismuth germanate (BGO) detectors which span an angular range from 45° to 145° in the reaction plane. With this system it is possible to simultaneously measure the cross section and angular distribution of gamma-rays as a function of neutron energy. The results for the cross section of the /sup 12/C(n,n'γ = 4.44 MeV) reaction at 90° and 125° show good agreement with previous measurements, while the complete angular distributions show the need for a large a_4 coefficient which was not previously observed. Preliminary results for the /sup 12/C(n,n'γ = 15.1 MeV) reaction have also been obtained. The data obtained for the /sup 40/Ca(n,γ_0) reaction in the region of the giant dipole resonance demonstrate the unique capabilities of this system. Future developments to the neutron source which will enhance the capabilities of the system will be presented.

16828 **Heavy-ion radiative capture of $^{12}C+^{14}C$ into ^{26}Mg.** Ricken, L.; Sandorfi, A.M.; Dowell, D.H.; Paul, P. (State University of New York, Stony Brook, NY 11794 and Ruhr-Universitaet Bochum, 4630 Bochum, West Germany). *AIP (American Institute of Physics) Conference Proceedings;* 125: No. 1, 705-708(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

The radiative capture of ^{12}C by ^{14}C into the fused nucleus ^{26}Mg has been investigated for E/sub C//sub M/ = 6.2—8.1 MeV. Structures are observed in the excitation functions for γ-decay to the bound states up to E/sub x/ = 5.7 MeV in ^{26}Mg. The lack of any structure in elastic scattering and fusion suggests that these might reflect the electromagnetic strength function built upon the low-lying levels of ^{26}Mg. However, the experiment indicates considerable differences between these strength functions for the different final states.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

16829 (BNL—40536) **Measurement of energy and charged particle emission in the central rapidity region from O + A and p + A collisions at 14.5 GeV/c per nucleon and preliminary results from Si + A collisions.** Abbott, T.; Akiba, Y.; Alburger, D.; Beavis, D.; Betts, R.R.; Bloomer, M.A.; Bond, P.D.; Chasman, C.; Chu, Y.Y.; Cole, B.A. (Brookhaven National Lab., Upton, NY (USA); Argonne National Lab., IL (USA); Columbia Univ., Irvington-on-Hudson, NY (USA). Nevis Labs.; Hiroshima Univ. (Japan); Lawrence Berkeley Lab., CA (USA); Massachusetts Inst. of Tech., Cambridge (USA)). 1987. Contract AC02-76CH00016;AC03-76SF00098;W-31109-ENG-38. 26p. (CONF-8708202—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004858/JAW.

From Quark matter '87: 6th international conference on ultra-relativistic nucleus-nucleus collisions; Schloss Nordkirchen, F.R. Germany (1 Aug 1987).

The first data from a 160 beam of total energy 232 GeV at the BNL Tandem-AGS are discussed. Preliminary results from a ^{28}Si beam of total energy 406 GeV are also shown. The full complement of E-802, including a magnetic spectrometer, was used for the ^{28}Si measurement. A different experimental arrangement was used for 160. Comparison measurements with proton beams are presented for both configurations. 12 refs., 12 figs.

16830 (CRN-PN—87-09) **Gamow-teller beta decay of / sup 29/Na and comparison with shell-model predictions.** Baumann, P.; Dessagne, P.; Huck, A. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1987. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751377/JAW.

Gamma radiation and delayed neutrons following the decay of /sup 29/Na have been studied in singles and coincidence mode with mass-separated sources at the ISOLDE facility. Evidence for a first excited state in /sup 29/Mg at 54.6 keV has been found, in good agreement with theoretical predictions. From the lifetime, deduced from γ-γ delayed coincidences with BaF/sub 2/ counters, a transition strength is found for the 55 keV (1/2/sup +/)-> g.s. (3/2/sup +/) transition. A level scheme built on the new state at 55 keV and involving five new transitions has been established for bound levels in /sup 29/Mg. The features of these levels are compared with predictions of shell-model calculations, with which they substantially agree. In the neutron time-of-flight spectra, high-energy neutron branches have been found in addition to the previously reported decays. The observed distribution of the Gamow-Teller transition strengths with excitation energy for particle-unbound levels in /sup 29/Mg is found to be shifted upward by about 1 MeV relative to shell-model predictions.

16831 (DOE/ER/40321—1) **[Reaction mechanism studies of heavy ion induced nuclear reactions]: Annual progress report, October 1987.** Mignerey, A.C. (Maryland Univ., College Park (USA). Dept. of Chemistry). Oct 1987. Contract FG05-87ER40321. 34p. (ORO—5172-0029). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004529/JAW.

The experiments which this group has been working on seek to define the reaction mechanisms responsible for complex fragment emission in heavy ion reactions. The reactions studied are La + La, La + Al, and La + Cu at 46.8 MeV/u; and Ne + Ag and Ne + Au reactions at 250 MeV/u. Another experimental program at the Oak Ridge Hollifield Heavy Ion Research Facility (HHIRF) is designed to measure the excitation energy division between reaction products in asymmetric deep inelastic reactions. A brief description is given of progress to date, the scientific goals of this experiment and the plastic phoswich detectors developed for this experiment. (DWL)

16832 (GANIL-P—87-03) **Observation of a bound Tz = -3 nucleus: /sup 22/Si.** Saint-Laurent, M.G.; Anne, R.; Dufour, J.P. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753192/JAW.

First evidence of the nucleus /sup 22/Si (Tz=-3) is observed by projectile fragmentation of /sup 36/Ar at 85 MeV/u.

16833 (INIS-SU—428, pp 26-33) **To anomalon interpretation of /sup 40/Ar+Cu collisions at 0.9 and 1.8 GeV per nucleon energies.** Tolstov, K.D. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780044/JAW. (JINR-N—1[21]-87).

In JINR rapid communications. Collection.

The paper concerning the results of inelastic collisions of 1.8 and 0.9 GeV per nucleon /sup 40/Ar with copper is discussed. The authors Dersch and Beckman explained their experiment results on the basis of anomalons of lifetime r ~ 2x10/sup -10/ s and/or "inconsistency with the known nuclear physics". In the present search it is shown that such conclusions are untenable, and the data obtained by the authors are explained by the known physics regularities. 15 refs.; 3 figs.; 3 tabs.

16834 (INIS-SU—431, pp 350) **Total cross sections of α particle interaction with Mg and Al nuclei.** Domnikov, V.N.; Dubar, L.V.; Zybin, V.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16835 (INIS-SU—431, pp 374) **Photoexcitation of short-lived isomeric state on Cl and Br nuclei.** Gutij, A.I.; Salontaj, A.S.; Sabolchuj, N.T.; Kostyu, Ya.Eh.; Parlag, A.M.; Shabalina, L.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16836 **(LBL—24217) The beta decay asymmetry parameter of ^{35}Ar.** Garnett, J.D. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88003859/JAW.

The beta decay asymmetry parameter for ^{35}Ar = ^{35}Cl + e$^+$ + nu/sub e/ has been remeasured in order to resolve a long standing puzzle. Previous asymmetry measurements, when combined with the comparative half-life, yield a value for the vector coupling constant, G/sub v/, that is in serious disagreement with the accepted value. We produced polarized ^{35}Ar by a (p,n) reaction on ^{35}Cl using the polarized proton beam provided by Lawrence Berkeley Laboratory's 88-Inch Cyclotron. The polarization of the ^{35}Ar was determined by measuring the asymmetry of the positrons produced in ^{35}Ar decay to the first excited state in ^{35}Cl (branching ratio = 1.3%) in coincidence with a 1219.4 keV gamma ray. Our result, A_0 = 0.49 +- 0.10, combined with the comparative half-life yields a value for G/sub v/ in agreement with the accepted value.

16837 **β-decay asymmetry parameter for /sup 35/Ar: An anomaly resolved.** Garnett, J.D.; Commins, E.D.; Leako, K.T.; Norman, E.B. (Physics Department, University of California, Berkeley, California 94720). *Physical Review Letters;* **60**: No. 6, 499-502(8 Feb 1988).

A remeasurement of the β-decay asymmetry parameter for /sup 35/Ar decay to the ground state of /sup 35/Cl has been performed. The result, A_0 = 0.49 +- 0.10, leads to a value for the quark mixing angle θ/sub C/ = 0.28 +- 0.08 rad, in agreement with the accepted value 0.23 +- 0.01 and in strong disagreement with the anomalous result θ/sub C/<0.10 (95% confidence level) determined from previous measurements of this asymmetry parameter.

16838 **/sup 28/Si+/sup 14/N orbiting interaction.** Shivakumar, B.; Shapira, D.; Stelson, P.H.; Ayik, S.; Harmon, B.A.; Teh, K.; Bromley, D.A. (A.W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 2, 652-663(Feb 1988).

The charge and mass distribution of orbiting yields from the /sup 28/Si+ /sup 14/N interaction have been studied at center of mass energies between 30 and 56.7 MeV. The data indicate that the orbiting system lives sufficiently long for the exit channel yields to be determined by phase space considerations. The data are compared with compound nucleus and orbiting calculations, and clearly favor the latter. Further comparisons between the data and the orbiting calculations indicate that full phase space equilibration of the orbiting yields is hindered at low excitation energies by the inaccessibility of single nucleon transfer channels. Also evident in the data is a correlation in the behaviors of the charge width, mass width, and final product kinetic energies, which is interpretable as arising from a maximum angular momentum that the /sup 28/Si+ /sup 14/N orbiting composite can sustain.

16839 **Sharing of the excitation energy in the initial stages of nucleus-nucleus collisions.** Korolija, M.; Cindro, N.; Caplar, R. (Rudjer Boskovic-acute-accent Institute, 41001 Zagreb, Croatia, Yugoslavia). *Physical Review Letters;* **60**: No. 3, 193-196(18 Jan 1988).

Inclusive proton spectra from reactions induced by /sup 16/O, /sup 32/S, and /sup 58/Ni projectiles have been decomposed by use of a refined multisource analysis. Yields from central-like collisions have been extracted and compared with Boltzmann—master-equation predictions. The comparison yields the initial number of degrees of freedom, n_0. The excitation energy per initial degree of freedom, E/sup *//n_0, is found to be essentially independent of the colliding masses, depending only on the per nucleon energy of the projectile. An empirical relation connecting E/sup *//n_0 with the available incident energy is given.

16840 **Proton resonances in /sup 32/S from E/sub x/ = 9.83 to 12.74 MeV.** Fang, D.F.; Bilpuch, E.G.; Westerfeldt, C.R.; Mitchell, G.E. (Duke University, Durham, North Carolina 27706). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 1, 28-40(Jan 1988).

Differential cross sections for the /sup 31/P(p,p_0), (p,p_1), (p,α_0), and (p,α_1) reactions were measured in the range E/sub p/ = 1.00 to 4.01 MeV with an overall resolution of about 400 eV. The resonance parameters were extracted for 143 levels with a multilevel, multichannel R-matrix code. These parameters include resonance energy, total angular momentum, parity, partial widths, channel spin or orbital angular momentum mixing ratios, and, for some resonances, the relative signs of width amplitudes. Eight isobaric analog resonances were identified in /sup 32/S. Proton resonance strengths were compared with shell model predictions. The /sup 31/P(p,α_0) data were used to obtain the reaction rates for the inverse reaction /sup 28/Si(α,p_0).

16841 **Fragmentation of /sup 16/O projectiles at 100 MeV per nucleon.** Silk, J.D.; Holmgren, H.D.; Hendrie, D.L.; Symons, T.J.M.; Westfall, G.D.; Stelson, P.H.; Raman, S.; Auble, R.L.; Wu, J.R.; Van Bibber, K.; and others. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 1, 158-162(Jan 1988).

Energy and angular distributions of heavy (Z≧4) projectile-like residues of /sup 16/O have been measured at 100 MeV/nucleon with better than unit A and Z resolution. Global fits to the isotopic distributions show close correspondence to the relativistic results. Closer examination reveals angle dependent damping of the fragmentation peak. The dependence of this damping upon the target mass gives evidence that the scattering outside the grazing angle is to positive angles.

16842 **Target/projectile mass dependence of light ion yields from heavy ion collisions.** Auble, R.L.; Ball, J.B.; Bertrand, F.E.; Ferguson, R.L.; Lee, I.Y.; Robinson, R.L.; Young, G.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 1, 390-392(Jan 1988). Contract AC05-84OR21400.

Differential cross sections for emission of Z = 1 and 2 particles are measured for /sup 16/O, /sup 32/S, and /sup 58/Ni projectiles, with energies between 15 and 25 MeV/nucleon, incident on Al, Ti, Ni, Sn, and Au targets. Integral yields are found to have a complex target mass dependence which, for protons, is consistent with model predictions.

16843 **Asymmetric fission of /sup 56/Ni.** Sanders, S.J.; Kovar, D.G.; Back, B.B.; Beck, C.; Dichter, B.K.; Henderson, D.; Janssens, R.V.F.; Keller, J.G.; Kaufman, S.; Wang, T.h.; and others. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **59**: No. 25, 2856-2859(21 Dec 1987). Contract W-31-109-ENG-38.

Cross sections for the two-body channels populated in the /sup 32/S+ /sup 24/Mg reaction at E/sub c.m./ = 60.8 MeV have been measured by use of a coincidence technique which allows correction for secondary light-particle evaporation. The data show reaction yields with full equilibration of energy and mass-asymmetry coordinates. These results suggest an asymmetric fission mechanism and are contrary to what is expected from the previously proposed "orbiting" mechanism in light systems.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

16844 (INIS-mf—11093, pp 8-9) **/sup 40/Ar levels at 9 to 10 MeV studied by the reaction /sup 36/S(α,γ)/sup 40/Ar.** Jozsa, M.; Kiss, A.Z.; Koltay, E.; Nyako, B.; Somorjai, E.; Keinonen, J. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete; Helsinki Univ., Finland). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

16845 **(ISN—87-45) Two-nucleon high-spin states, the Bansal-French model and the crude shell-model.** Ung Chan, T. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). May 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751407/JAW.

Recent data on two-nucleon stretched high-spin states agree well with the Crude Shell-Model predictions. For two-neutron high-spin states, the A and T linear dependence of B/sub 2n/ in the Bansal-French Model can be deduced from the A and T linear dependence of B/sub n/ and the Crude Shell-Model. 7/sup -//sub 2/ states in some Zn and Ge even nuclei might be two-proton states. This hypothesis should be confirmed by two-proton transfer reaction.

16846 **(JINR-E—1-86-607) Spallation of nickel by 9 GeV/c protons and deuterons.** Kozma, P.; Kliman, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700261/JAW.

Submitted to the journal Phys. Lett. B.

Cross sections for the production of radionuclides in the interaction of nickel target with 9 GeV/c protons and 9 GeV/c deuterons were determined by the activation technique. Charge- and mass-distributions were deduced from these data. 8 references, 2 figures, 1 table.

16847 (LYCEN—8702, pp S.12.1-S.12.7) **Spin - isospin volume and surface responses in nuclei.** Alberico, W.M. (Turin Univ., Italy; I.N.F.N., Turin, Italy). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

We investigate the spin-longitudinal and spin-transverse isovector responses of a finite nucleus within the RPA framework. We also distinguish between volume responses, where the external probe can excite any nucleon in the nucleus, and surface responses, where the excitation mainly involves the surface nucleons. The two types of responses show significative differences.

16848 **Energy dependence of neutron-proton matrix element ratios derived from 25—800 MeV energy proton scattering.** Hintz, N.M.; Cook, D.; Gazzaly, M.; Franey, M.A.; Barlett, M.L.; Hoffmann, G.W.; Fergerson, R.; McGill, J.; Pauletta, G.; Boudrie, R.L. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 2, 692-709(Feb 1988).

New data are presented on elastic and inelastic proton scattering by /sup 58/Ni at 333 and 498 MeV and /sup 208/Pb at 318 MeV. We have analyzed these data using phenomenological distorting potentials and potentials generated by folding neutron and proton densities with a free nucleon-nucleon t matrix or with a medium modified nucleon-nucleon interaction. Making use of electromagnetic matrix elements, or charge transition densities, we have calculated neutron-proton transition matrix element ratios in the vibrating potential—vibrating density model ("collective form factors"), or with a scaling model in which the neutron transition densities are taken as proportional to the proton densities. In addition, we have calculated, neutron-proton matrix element ratios from earlier (p,p') results at 25—800 MeV for /sup 40/Ca, /sup 58/Ni, and /sup 208/Pb. We conclude that, although there are some irregularities, the derived neutron/proton matrix element ratios for natural parity states show a tendency to decrease in magnitude with decreasing proton energy in the range 500—100 MeV. A quantitatively similar effect is seen in the ratio of experimental to theoretical cross sections, where the latter are calculated using transition densities adjusted to fit electron or 800 MeV proton scattering. We attribute these results to a failure of the impulse approximation and the vibrating potential model in this energy region.

16849 **Pion inelastic scattering from /sup 48,50/Ti, /sup 52/Cr, and /sup 54,56/Fe: Higher-lying states.** Oakley, D.S.; Smithson, M.J.; Mordechai, S.; Moore, C.F.; Seidl, P.A.; Morris, C.L.; Seestrom-Morris, S.J.; Gilman, R.; Zumbro, J.D.; Fortune, H.T. (University of Texas at Austin, Austin, Texas 78712). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 2, 866-869(Feb 1988).

Differential cross sections are presented for pion elastic and inelastic scattering from /sup 48,50/Ti, /sup 52/Cr, and /sup 54,56/Fe at T/sub π/ = 180 MeV to the 0^+, 5^-, and higher lying 2^+, 3^-, and 4^+ states. Inelastic-scattering data were analyzed using distorted-wave impulse-approximation calculations with collective-model transition densities. Matrix elements for most of the transitions have been extracted.

16850 **Low-energy pion double charge exchange on Ca isotopes.** Weinfeld, Z.; Piasetzky, E.; Baer, H.W.; Burman, R.L.; Leitch, M.J.; Morris, C.L.; Wright, D.H.; Rokni, S.H.; Comfort, J.R. (Raymond and Beverly Sackler Faculty of Exact Science, Tel Aviv University, Ramat Aviv, Israel). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 2, 902-905(Feb 1988).

Differential cross sections for the double-isobaric-analog-state transition in the /sup 42,44/Ca(π^+,π^-) reactions were measured at an incident energy of 35 MeV and 40 degrees. The /sup 42/Ca cross section (2.0 +- 0.5 μb/sr) is nearly as large as those of the lighter T = 1 nuclei and only slightly smaller than that previously measured for /sup 48/Ca (2.4 +- 0.7 μb/sr). The cross section for /sup 44/Ca (1.1 +- 0.3 μb/sr) is half of this amount. These results are surprising when compared with simple expectations and point to the importance of the nonanalog route contribution at low energies.

16851 **Lifetimes of yrast and near-yrast states of /sup 159,160,161/Yb.** Fewell, M.P.; Johnson, N.R.; McGowan, F.K.; Hattula, J.S.; Lee, I.Y.; Baktash, C.; Schutz, Y.; Wells, J.C.; Riedinger, L.L.; Guidry, M.W. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 1, 101-117(Jan 1988). Contract AC05-84OR21400.

Lifetimes of high-spin states of /sup 159,160,161/Yb, populated by fusion-evaporation reactions, have been measured by the recoil-distance technique. The data were collected in coincidence with a total-energy filter to provide some discrimination on reaction channel. The principal feature of the resulting transition quadrupole moments is a frequency-dependent reduction which is displayed by those bands with aligned quasiparticles. This seems to be mainly due to the influence of the favored i/sub 13/2/ quasineutron. Additional available data are surveyed and support this conclusion. Calculations using the cranked shell model and the cranked Hartree-Fock-Bogoliubov and cranked Nilsson-Strutinsky methods provide a qualitative description of the experimental observations. In addition, a satisfactory account is provided by recent calculations based on a fermion dynamical-symmetry model.

16852 **Recent results from proton capture to giant resonances built on high-excited states.** Dowell, D.H. (Brookhaven National Laboratory, Upton, New York, 11973, USA). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 597-611(15 Jan 1985). (CONF-840906—). Contract AC02-76CH00016.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

New measurements of the (p,γ) reaction on natural targets of K and Ca at intermediate proton energies (E/sub p/ = 11 to 36 MeV) reveal excitation functions that are dominated by excited-state giant dipole resonances (ESGDR's) built upon single-particle states in ^{40}Ca and ^{41}Sc. These ESGDR's all peak near E/sub γ/ =

20 MeV and have widths which increase monotonically with the final states's excitation energy. The integrated, inverse (γ,p$_0$) cross sections are shown to be proportional to the known single-particle spectroscopic strengths indicating a semi-direct mechanism for the capture process.

16853 **Neutron capture and total cross sections for ^{48}Ca: Astrophysical implications.** Carlton, R.F.; Harvey, J.A.; Hill, N.W.; Macklin, R.L. (Middle Tennessee State University, Murfreesboro, TN 37132). *AIP (American Institute of Physics) Conference Proceedings;* 125: No. 1, 774-777(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Attempts to understand abundance anomalies of the Ca isotopes in the Allende meteorite via the nβ-process require 30-keV Maxwellian averaged capture cross sections. Experimental data on ^{48}Ca in this energy region of astrophysical significance is important since a single resonance in this vicinity could dominate the caputre cross section. Neutron capture and total cross section measurements have been performed at ORELA on a 9.97-g sample of $CaCO_3$, enriched to 96% ^{48}Ca, over the energy ranges 10 eV-500 keV ($\sigma\gamma$) and 10 keV-4 MeV (σT). Only two small resonances were found for ^{48}Ca in the 30-keV energy region (at 19.3 and 106.9 keV) and those only in capture. Their contribution to the 30-keV-averaged cross section is only 50 μb compared to 1.0 mb calculated from direct capture. The p-wave strength and large d/sub 5/2/ strength observed above 150 keV do no contribute significantly to the 30 keV capture.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

16854 **(BNL—40596) Is the region above ^{78}Ni doubly magic?.** Hill, J.C.; Winger, J.A.; Wohn, F.K.; Gill, R.L.; Piotrowski, A.; Ji, X.; Wildenthal, B.H. (Ames Lab., IA (USA); Brookhaven National Lab., Upton, NY (USA); Drexel Univ., Philadelphia, PA (USA)). 1987. Contract AC02-76CH00016;W-7405-ENG-82. 10p. (CONF-870970—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004865/JAW.

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

The region above ^{78}Ni would be doubly magic if the numbers Z = 28 and N = 50 retain their magic character far to the neutron-rich side of stability. We report results of a study of the states in ^{82}Ge (^{78}Ni core + 4 protons) and ^{83}As (^{78}Ni core + 5 protons) populated in the β^- decay of ^{82}Ga and ^{83}Ge, respectively. Mass separated sources were produced at the TRISTAN separator facility. The measured level schemes were compared to shell-model calculations in which we assume an inert ^{78}Ni core and extra-core protons that are allowed to fill with minor restrictions all orbits between Z = 28 and 50. The calculations are generally in good agreement with the measurements except for a level in ^{83}Ge at 711 keV which cannot be easily explained. Finally, the degree to which ^{78}Ni can be considered a valid doubly magic core is discussed. 13 refs., 6 figs.

16855 **(CRN-PN—87-07) Identification of the 9/2/sup +/ to 5/2/sup -/ transition in /sup 69/Se.** Ramdane, M.; Baumann, P.; Dessagne, P.; Huck, A.; Klotz, G.; Miehe, C.; Walter, G. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751376/JAW.

Gamma rays from /sup 69/Se have been investigated using the reaction /sup 40/Ca(/sup 32/S,2pinγ)/sup 69/Se between 80 and 110 MeV beam energy. Isotopic identification was based on excitation functions, n-γ coincidences as well as genetic relationships. The first excited state was found to be at 534.8 +- 0.3 keV and its half-life has been measured. The excitation energy is consistent with the systematic trend of the first 9/2/sup +/ state in the N=35 and N=37 isotones. The lifetime reveals the same degree of inhibition as in analogous M2 (9/2/sup +/ -> 5/2/sup -/) transitions. A first level scheme, including three levels in /sup 69/Se, is proposed.

16856 (HMI—437, pp 33-44) **Rigid rotation versus shape coexistence in the N ≃ Z ≃ 36 region.** Lieb, K.P. (Goettingen Univ., Germany, F.R. 2. Physikalisches Inst.). 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751499/JAW.

In Heavy ion physics at the VICKSI accelerator. A selection of research reports of external research groups.

Recent lifetime measurements in the light Se, Br, Kr and Rb isotopes with N ≃ Z using /sup 36/Ar and /sup 40/Ca induced reactions point to rapid variations of the nuclear shape as function of the rotational frequency and particle number. This behaviour is intimately connected with the subshell closures at large prolate or oblate deformation.

16857 (IN2P3—86-01, pp 445-471) **Double beta decay: introduction, motivations and last results.** Hubert, P. (Bordeaux-1 Univ., 33 - Gradignan, France. Centre d'Etudes Nucleaires). 1986. (In French). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751391/JAW. (CONF-8609338—).

From Joliot Curie school of nuclear physic: symmetries and nuclear physics; Maubuisson, France (15 Sep 1986).

The double β decay process is the direct desexcitation from a nucleus (Z,A) to a nucleus (Z+2, A). Since long time ago, study of this process has been recognized as a very sensitive test of the lepton number non-conservation and therefore the double β decay process is strongly connected to the neutrino properties. This review starts with the main definitions and main motivations for such studies. Then the different experiments actually running and the most recent experimental results are exposed.

16858 (INIS-mf—11093, pp vp) **Elastic scattering of alpha particles on /sup 62/Ni.** Mate, Z.; Szilagyi, S.; Zolnai, L.; Brenner, M.; Kaellman, K.-M.; Manngard, P.; Sjoeberg, A. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete; Aabo Akademi, Turku, Finland. Dept. of Physics). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

16859 (INIS-SU—431, pp 62) **Multipole mixture of γ-transitions in /sup 70,74/Ge.** Dostemesova, G.A.; Kaipov, D.K.; Kosyak, Yu.G. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16860 (INIS-SU—431, pp 64) **Probability of E2-transitions in /sup 85/Sr yrast band.** Zhovliev, U.J.; Kudoyarov, M.F.; Kul'dzhanov, I.K.; Muminov, A.I.; Pasternak, A.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16861 (INIS-SU—431, pp 307) **Investigation of excitation functions in proton scattering on /sup 70/Zn, /sup 102/Pd, /sup 63,65/Cu nuclei.** Antropov, A.E.; Zarubin, P.P.; Khrisanfov, Yu.V.; Gusev, V.P. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16862 (INIS-SU—431, pp 334) **Analysis of spectra and angular distribution of charged particles from the /sup 58,60,61,62,64,/Ni+α and /sup 63,65/Cu+α reactions.** Smirnov, A.V.; Antropov, A.E.; Zarubin, P.P.; Khrisanfov, Yu.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16863 (INIS-SU—431, pp 397) **Production of residual nuclei in the /sup 12/C + /sup 64/Cu interaction at 104 MeV.** Gradechny, Ch.; Kliman, Ya.; Kozma, P.; Kugler, A.; Leonard, M. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16864 **(IPNO-DRE—87-14) Identification of the new neutron-rich isotopes /sup 70-74/Ni and /sup 74-77/Cu in thermal neutron fission of /sup 235/U.** Armbruster, P.; Boquet, J.P.; Faust, H.R.; Brissot, R.; Bernas, M.; Roussel, P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751742/JAW.

The unknown isotopes /sup 70-74/Ni and /sup 74-77/Cu were identified in thermal neutron fission of /sup 235/U, using the recoil separator LOHENGRIN and ΔE-E detection techniques. Isotopic yields, for preselected values of ionic charge and kinetic energy of the fission fragments in the mass range A = 70-80, were measured down to 10/sup -9/ fragments/fission (f./f.). Mass yields for the masses 70 and 71 and elemental yields for nickel and copper are estimated.

16865 **(IPNO-DRE—87-15) Spectroscopy of neutron-rich isotopes of nickel and iron.** Girod, M.; Dessagne, P.; Bernas, M.; Langevin, M.; Pougheon, F.; Roussel, P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 55p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751743/JAW.

Spectroscopy of neutron rich isotopes of /sup 67/Ni, /sup 68/Ni and /sup 62/Fe is studied using the quasi-elastic transfer reactions (/sup 14/C, /sup 16/O) and (/sup 14/C, /sup 17/O) on mass separated targets of /sup 70/Zn and of /sup 64/Ni. The structure of these new nuclei is investigated through the Hartree-Fock-Bogoliubov (HFB) calculations, using the D1SA interaction. Inertial parameters are calculated in the cranking approximation. Collective excited states are obtained consistently by solving the Bohr Hamiltonian. Based on these results, quantum numbers are tentatively assigned to the observed states and angular distributions, measured and calculated from the DWBA, are used to check this assignment. The spectroscopy of more neutron rich nuclei, yet unknown, is anticipated. A sharper test of wave functions is provided by the monopole operator of the O/sub 2//sup +/ -> O/sub 1// sup +/ transition in /sup 68/Ni, which have been deduced from the halflife measurement performed in delayed coincidence experiments. An impressive agreement is obtained between the measured halflife and its value calculated using complete HFB wave functions.

16866 **(JINR-E—1-86-606) Spallation of copper by 9 GeV/c protons and deuterons.** Kozma, P.; Kliman, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700260/JAW.

Submitted to the journal Zeitschrift Phys.

The spallation of copper by 9 GeV/c protons and deuterons has been studied. Cross sections for the production of radionuclides with mass number $24 \leqq A \leqq 60$ were determined from direct gamma-ray counting of irradiated targets with a Ge(Li)-spectrometer. The results were parametrized in terms of a 6-parameter equation which reproduces the measured charge and mass distributions. The proton results are compared with previous investigations. 16 references, 3 figures, 5 tables.

16867 (LYCEN—8702, pp C.2.1-C.2.16) **Studies of nuclear behaviour with Chateau de Cristal.** Beck, F.A. (Centre de Recherches Nucleaires, 67-Strasbourg, France). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Since 1985 the French $4\pi\gamma$ multidetector system Chateau de Cristal has been used in numerous experiments devoted to studying nuclear shape change, search for superdeformation at high angular momentum as well as nuclear reaction mechanism. Good timing properties of the BaF/sub 2/ crystals newly developed for this apparatus enable an efficient on line neutron-gamma discrimination by the time of flight technique an also an efficient isomer selection in the nanosecond range. A summary of the first experiments performed with Chateau de Cristal is presented. These new results concern several nuclei from the mass regions ranging from A ~ 100 to A ~ 200.

16868 **Giant dipole resonances built on isobaric analog states in pion double charge exchange.** Mordechai, S.; Auerbach, N.; Burleson, A.G.R.; Dhuga, K.S.; Dwyer, B.M.; Faucett, J.A.; Fortune, H.T.; Gilman, R.; Greene, C.S.J.; Laymon, C. (Ben-Gurion University of the Negev, Beer-Sheva 84105, Israel). *Physical Review Letters;* 60: No. 5, 408-411(1 Feb 1988).

Giant resonances were observed in (π^+,π^-) double charge exchange (at T/sub π/ = 292 MeV) on /sup 56/Fe, /sup 80/Se, and /sup 208/Pb at excitation energies of 28.5, 34.6, and 43.6 MeV, respectively. An angular distribution for /sup 56/Fe was measured and observed to have a dipole shape. The variation of excitation energy above the double isobaric analog state is consistent with an A/sup -1/3/ dependence, as expected for giant dipole resonances built on the isobaric analog states. The /sup 56/Fe angular distribution agrees well with a coupled-channels impulse-approximation calculation in which sequential single charge exchange through the isobaric analog to the giant dipole resonance is evaluated.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

16869 **(CEA-CONF—9025) Limiting temperatures of medium mass nuclei.** Fabris, D.; Hagel, K.; Mazur, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Apr 1987. 4p. (CEA-DPH-N-S—2452B; CONF-8704188—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751340/JAW.

From Symposium on central collisions and fragmentation processes; Denver, CO, USA (7 Apr 1987).

A limiting temperature of ~ 6 MeV is found for α emission from medium mass nuclei having excitation energies of 2 to 4.5 MeV/nucleon. This result is consistent with model predictions for a "cracking" phase transition.

16870 **(CENBG—8616) Recent Developments in the study of (n, α) reactions on heavy nuclei.** Glowacka, L.; Jaskola, M.; Turkiewics, J.; Gadioli, E.; Gadioli Erba, E.; Zemlo, L.; Dalmas, J.; Chiadli, A. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). May 1986. 4p. (CONF-8605166—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751364/JAW.

From International conference on fast neutron physics; Dubrovnik, Yugoslavia (26 May 1986).

The energy and angular distributions of α-particles emitted in (n, α) reactions induced by 14.3 and 18.1 MeV neutrons on Zirconium nuclei (one with a magic neutron shell and the other with one more neutron outside the shell) have been measured and compared with each other.

16871 **(CENBG—8624) Nuclear reactions induced by / sup 12/C and /sup 40/Ar on targets of average and heavy mass at intermediate energies.** Pravikoff, M.S. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). Dec 1986. 208p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88751732/JAW.

Cross sections mean recoil ranges, isomeric ratios an angular distributions of radioactive α emitters produced in /sup 12/C and / sup 40/Ar induced reactions on thick medium to heavy targets are presented. Experiments were made on the CERN Synchro Cyclotron (/sup 12/C at 86 MeV/u), SARA (20 and 30 MeV/u /sup 12/C beam) and GANIL (/sup 40/Ar at 44 MeV/u) facilities. The experimental set up is based on the electrostatic collection in gases, in conjunction with a gas transport system. Experimental results con-

firm the "residue corridor" concept. At 20 and 30 MeV/u of /sup 12/C, incomplete fusion and preequilibrium emission are typical features of the reaction. Therefore we developed such an incomplete fusion model, coupled to a preequilibrium and statistical evaporation code which reproduces quite well the cross-section distributions. For the higher incident energies, comparisons between calculations made according to a pure abrasion-ablation model, intranuclear cascade codes and the incomplete fusion picture and experiments are presented.

16872 (CRN-PN—87-11) **Fast rotating nuclei studies with Chateau de Cristal.** Beck, F.A. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). May 1987. 25p. (CONF-8705201—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751378/JAW.

From 22. Zakopane school of physics; Zakopane, Poland (1 May 1987).

The French $4\pi\gamma$ multidetector system Chateau de Cristal has been used since 1985 in numerous experiments devoted to nuclear shape change and shape coexistence at high angular momentum as well as nuclear reaction mechanism studies. In the first kind of measurements a Chateau of 38 counters associated to 12 Ge with Compton suppressors has been used while in the second case the γ-particle and multiplicity measurements were done with a Chateau of 74 counters. The individual counters of Chateau de Cristal are BaF/sub 2/ crystals which we have developed for the first time as large γ detectors (efficient and fast). A summary of several experiments performed with Chateau de Cristal is presented. This data concern several fast rotating nuclei studies ranging from A $\sim$ 120 to A $\sim$ 200.

16873 (INIS-mf—11093, pp 5-7) **Excited states of /sup 110/In, /sup 112/In and /sup 114/In observed in (p,nγ) reactions.** Krasznahorkay, A.; Kibedi, T.; Timar, J.; Fenyes, T.; Passoja, A.; Julin, R.; Kumpulainen, J.; Paar, V. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete; Jyvaeskylae Univ., Finland. Dept. of Physics; Zagreb Univ., Yugoslavia. Prirodoslovno Matematicki Fakultet). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

Proton-induced reactions of Cd nuclei were investigated by gamma spectroscopy, and the level structure of the produced In nuclei was derived. 330 gamma transitions were evaluated in the 3 analyzed nuclei, branching ratios, transition multipolarities, spin and parity values were deduced. The presence of proton-neutron multiplet states was discussed on the basis of the parabolic rule derived from the cluster-vibration model. (D.Gy.). 1 ref.; 3 figs.

16874 (INIS-mf—11093, pp 14-16) **Nuclear structure studies in the rare-earth region.** Arvay, Z. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

The properties of rare-earth nuclei were investigated both theoretically and experimentally. The interacting boson-fermion model was used to derive the energy-level scheme of odd parity states of Gd-149 and Gd-151, and M1, E2 transition probabilities between them. Taking into account one quasiparticle the analysis can be extended to the border of the region of deformed nuclei, to the nuclei with 89 neutrons. For the experimental investigation of the short-living, beta unstable rare-earth isotopes a fast automatic spectrometer facility (ELGA) was constructed and built at JINR, Dubna, and was used for the study of Gd-153 nucleus. (D.Gy.). 11 refs.; 2 figs.

16875 (INIS-SU—431, pp 81-82) **Lifetimes and three-quasiparticle structure of /sup 109/In high spin states.** Kudoyarov, M.F.; Kuz'min, E.V.; Lobach, Yu.N.; Pasternak, A.A.; Tkachuk, I.P.; Trishin, V.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16876 (INIS-SU—431, pp 84) **Lifetimes of /sup 111/In excited states.** Kudoyarov, M.F.; Kuz'min, E.V.; Lobach, Yu.N.; Pasternak, A.A.; Tkachuk, I.P.; Trishin, V.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16877 (INIS-SU—431, pp 224) **New data on a course of the (γ,2γ) reaction on /sup 125m/Te nuclei.** Alpatov, V.G.; Bizina, G.E.; Godovikov, S.K. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16878 (INIS-SU—431, pp 113) **Determination of γ-transition multipolarity in La,Gd,Tb,Dy,Ho,Er,Tm and Yb nuclei on the basis of improved technique of beta-spectrogram processing.** Baratova, M.A.; Gromov, K.Ya.; Islamov, T.A.; Kononeko, G.A.; Tsupko-Sitnikov, V.M. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16879 (INIS-SU—431, pp 314) **Cross section of the (n,p) reaction on indium.** Leshchenko, B.E. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16880 (INIS-SU—431, pp 316) **Study on the radiative transition in the /sup 111/Cd(nγ)/sup 112/Cd reaction in the neutron energy range of 10-150keV.** Konobeevskij, E.S.; Mordovskoj, M.V.; Popov, V.I.; Potashev, S.I. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16881 (INIS-SU—431, pp 358) **Lifetimes of /sup 123/Te compound states.** Aprelev, M.V.; Kangropol', Yu.V.; Kudryavtsev, Yu.G.; Najdenov, E.G. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16882 (IPNO-DRE—87-09) **Preequilibrium proton emission in violent heavy-ion collisions around 30 MeV per nucleon.** Jouan, D.; Borderie, B.; Gardes, D. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Jan 1987. 17p. (CONF-870153—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751620/JAW.

From 25. international winter meeting on nuclear physics; Bormio, Italy (19 Jan 1987).

Protons emitted in coincidence with heavy residues resulting from incomplete fusion processes have been measured, for the reaction 27 MeV per nucleon /sup 40/Ar + /sup nat/Ag. From the proton velocity spectra, an anisotropic component was extracted, which shows a broad angular distribution, and a mean velocity larger than the beam velocity. Nevertheless, the average velocity along the beam axis is very close to the beam velocity, in agreement with the standard assumption usually made in order to derive the linear momentum transferred to the target, but the mean energy carried away by these protons is larger than the value commonly assumed.

16883 (LYCEN—8702, pp C.6.1-C.6.11) **On disintegration of highly excited nuclei.** Hildenbrand, K.D. (Gesellschaft fuer Schwerionenforschung GSI, Darmstadt, Germany, F.R.). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Dissipative Collisions at incident energies of 20 MeV/u lead to excitation energies in the intermediate system of up to 4 MeV/u with corresponding temperatures of more than 6 MeV. The highly excited emerging fragments display a variety of decay patterns such as emission of light particles, more complex fragments or fission. The ratio of two-body to three-body channels (two and three heavy ejectiles, respectively) has been investigated in Mo + Mo reactions at energies between 12 and 19 MeV/u. At total kinetic energy losses larger than 500 MeV the three-body channel is stronger than the two-body channel. For a given loss in total kinetic energy the intensity ratio of the two channels is independent of the bombarding energy. In the decay by light charged particles non-sequential components are clearly identified, which allows to establish a rough time scale of the emission.

16884 (LYCEN—8702, pp S.11.1-S.11.15) **Identification of proton rich exotic heavy nuclei and self-consistent study of triaxial deformations.** Redon, N.; Beraud, R.; Charvet, A. (Lyon-1 Univ., 69 - Villeurbanne, France. Institut de Physique Nucleaire). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Proton rich exotic nuclei of rare-earth have been identified and their low-energy structure studied with the system of He-jet fed on-line mass separator recently put into operation at the SARA accelerator. In order to investigate the triaxial stability of the deformed ground states in the e-e exotic Samarium isotopes, lattice Hartree-Fock + BCS calculations have been performed.

16885 (LYCEN—8702, pp S.15.1-S.15.7) **Superdeformed shapes in /sup 135/Nd and /sup 152/Dy.** Bacelar, J.C. (K.V.I., Groningen,, Netherlands). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Nuclei close to the shell closures (magic nuclei) tend to show reduced or no collectivity at the lowest spins, and their shapes are very unstable. In this region of unstable shapes other quite large shell gaps are expected to develop at high spins, for large deformation of the nuclear potential. To date only 3 cases are known. This paper is focused on results in /sup 135/Nd and /sup 152/Dy with the high resolution array (H.E.R.A.) at Berkely. For completeness, comments are made on the common properties of these structures, using also the results from Daresbury groups on /sup 152/Dy and /sup 132/Ce.

16886 (LYCEN—8702, pp S.14.1-S.14.5) **Peripheral reactions induced by /sup 22/Ne at 30 MeV/Nucleon.** Chbihi, A.; Billerey, R.; Chambon, B. (Lyon-1 Univ., 69-Villeurbanne, France Institut de Physique Nucleaire). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

The break-up of /sup 22/Ne has been studied in the /sup 22/Ne + /sup 93/Nb reaction at 30 MeV/nucleon. Singles projectile like fragments and correlation between projectile like fragments and α particles have been measured. We also observed coincidences between all pairs of Z = 3 to Z = 8 fragments and measured the energy correlations of the coincidence fragments. These correlations show the production mechanism to be mostly sequential break-up.

16887 (UCRL—97899) **Fragment production from 1 to 20 GeV p + Xe reactions.** Sangster, T.C. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 11p. (CONF-8711116—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005221/JAW.

From 8. high energy heavy ion study; Berkeley, CA, USA (16 Nov 1987).

The kinetic energy spectra of fragments ($2 \leq Z \leq 14$) from the interaction of 1 to 19 GeV protons and xenon nuclei have been measured using an internal gas jet target in the AGS main ring. It is observed that the shape of the energy spectra change radically as the incident proton energy decreases from about 10 GeV while at energies between 10 and 19 GeV, the shape of the spectra are identical to those measured using much higher proton energies. The evolution of the lower energy spectra can be viewed as the superposition of two components. One component is identical to the higher energy spectra; the second component is symmetrical and consistent with the fragment spectra emitted from a binary or asymmetric fission process. 14 refs., 2 figs.

16888 **Triple angular correlations in the decay of /sup 110/Ag/sup m/.** Krane, K.S.; Schulz, N.S. (Department of Physics, Oregon State University, Corvallis, Oregon 97331). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 2, 747-753(Feb 1988).

Double and triple gamma-ray angular correlations are reported for cascades in /sup 110/Cd following the decay of /sup 110/Ag. The 764-1505-658 keV triple correlation helps to resolve a long-standing ambiguity concerning the E2/M1 multipole mixing ratio of the 1505-keV transition. The potential of triple correlations to contribute to nuclear spectroscopy is thereby demonstrated.

16889 **Low-lying levels in /sup 148/Pm.** Norman, E.B.; Lesko, K.T.; Champagne, A.E. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California at Berkeley, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 2, 860-862(Feb 1988). Contract AC03-76SF00098.

The /sup 149/Sm(d,^{3}He) reaction has been used to populate levels in /sup 148/Pm. Nineteen new excited states have been observed below 1 MeV excitation energy in /sup 148/Pm. The possible astrophysical implications of these results are discussed.

16890 **Incomplete fusion reactions induced by /sup 12/C at 5.5—10 MeV/nucleon.** Tserruya, I.; Steiner, V.; Fraenkel, Z.; Jacobs, P.; Kovar, D.G.; Henning, W.; Vineyard, M.F.; Glagola, B.G. (Department of Nuclear Physics, The Weizmann Institute of Science, Rehovot, Israel). *Physical Review Letters;* **60**: No. 1, 14-17(4 Jan 1988).

Evaporation residues following the interaction of /sup 12/C with targets of /sup 197/Au, /sup 160/Gd, and /sup 120/Sn were measured in the energy range of E/sub lab/ = 5.5—10 MeV/nucleon. The experimental system allowed the determination of the cross sections of the complete fusion (CF) and the incomplete fusion (ICF) processes with a sensitivity to ICF processes below the percent level. The ICF processes were observed at all bombarding energies studied, down to energies slightly above the Coulomb barrier. The two processes have very different angular distributions, with ICF peaked at a significantly larger angle than the CF.

16891 **Multiplicity and bombarding energy dependence of the entropy in relativistic heavy-ion reactions.** Doss, K.G.R.; Gustafsson, H.; Gutbrod, H.H.; Hahn, D.; Kampert, K.; Kolb, B.; Loehner, H.; Poskanzer, A.M.; Ritter, H.G.; Schmidt, H.R.; and others. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 1, 163-168(Jan 1988).

The yield ratios of light clusters (d,t,^{3}He,α) to protons were measured for the reactions Nb + Nb and Au+Au for incident beam energies of 150, 250, 400, and 650 MeV/nucleon. The ratios are analyzed in the framework of the quantum statistical model and the specific entropy is extracted as a function of the participant proton multiplicity. The results are compared with predictions of the fireball model and relativistic mean field calculations.

16892 Quasi-elastic processes in /sup 58/Ni- and /sup 64/Ni-induced reactions on Sn isotopes. van den Berg, A.M.; Henning, W.; Lee, L.L.; Lesko, K.T.; Rehm, K.E.; Schiffer, J.P.; Stephans, G.S.F.; Wolfs, F.L.H.; Freeman, W.S. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 1, 178-186(Jan 1988). Contract W-31-109-ENG-38.

Quasi-elastic reactions were studied for /sup 58/Ni beams at 330 MeV and /sup 64/Ni beams at 341 and 380 MeV incident energy, respectively, on even-A Sn isotopes. Angular distributions were measured in the range $20^{\circ} \leqq \theta$/sub lab/$\leqq 55^{\circ}$ using a magnetic spectrograph with a gas-filled focal-plane detector yielding single mass and charge resolution; generally individual states were not resolved. Cross sections for quasi-elastic one-neutron pickup and stripping reactions vary smoothly with the ground-state Q value. Total quasi-elastic transfer cross sections range from 340 to 640 mb, corresponding to 20—40 % of the total reaction cross section determined from the elastic scattering angular distributions. The distribution of the total cross section into the various reaction channels is discussed.

16893 Intruder state collectivity at a double subshell closure from the beta decay of 0^- /sup 96/Y/sup g/ to the levels of /sup 96/Zr. Mach, H.; Molnar, G.; Yates, S.W.; Gill, R.L.; Aprahamian, A.; Meyer, R.A. (Clark University, Worcester, Massachusetts 01610, Brookhaven National Laboratory, Upton, New York 11973, University of Maryland, College Park, Maryland 20742). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 1, 254-264(Jan 1988). Contract AC02-79ER10493.

Levels of /sup 96/Zr populated following the β^- decay of the 0^- ground state of /sup 96/Y have been investigated by γ-ray and conversion electron singles, γ-ray multispectral scaling, γ-γ and γ-e^- coincidence, and γ-γ angular correlation measurements. These data have been used to establish the population of eight excited levels of /sup 96/Zr, to confirm the 0^+ assignment of the 2695-keV level, and to determine a half-life of 5.4(1) s for /sup 96/Y. The deduced beta transition strengths establish the decay to the ground state, with logft of 5.6, as one of the fastest first-forbidden decays known and support the notion of double subshell closure at Z = 40 and N = 56. The observed strong hindrance of transitions to excited 0^+ states is indicative of shape coexistence. The observed level pattern of the band built on the $0_3{}^+$ state exhibits similarities to nearby vibrational-like nuclei having four valence protons and four valence neutrons. A four-particle, four-hole interpretation of the $0_3{}^+$ state is supported by the data, and we determine a deformation parameter, $\beta_2 \sim 0.2$, for this intruder bandhead.

16894 Precision energy and intensity measurements for γ transitions from /sup 134/Cs decay. Wang, G.; Alburger, D.E.; Warburton, E.K. (Brookhaven National Lab., Upton, NY, USA). *Nuclear Instruments and Methods in Physics Research;* **260**: No. 2/3, 413-417(15 Oct 1987). Contract AC02-76CH00016.

The precision energies and relative intensities of 11 γ transitions from the decay of /sup 134/Cs have been determined. /sup 192/Ir, /sup 228/Th, /sup 137/Cs, /sup 110m/Ag, /sup 60/Co, and /sup 207/Bi served as energy calibration standards, and /sup 152/Eu and /sup 192/Ir as relative intensity calibration standards. Special care was taken in the analysis of data for the weaker transitions. The results are incorporated into a self-consistent decay scheme.

16895 Excitation of isovector monopole and quadrupole giant resonances in /sup 90/Zr(n,p) at 65 MeV. Ford, T.D.; Romero, J.L.; Brady, F.P.; Castaneda, C.M.; Drummond, J.R.; McEachern, B.; Sorenson, D.S.; Zin Aung; King, N.S.P.; Klein, A. (California Univ., Davis, USA. Crocker Nuclear Lab.; Los Alamos National Lab., NM, USA). *Physics Letters [Section] B;* **195**: No. 3, 311-315(10 Sep 1987).

The /sup 90/Zr(n,p)/sup 90/Y reaction at 65 MeV has been studied over a wide range of angles down to O/sup 0/. The data confirm the isovector monopole giant resonance recently observed in (π/sup +-/,π/sup 0/) data. In addition, the data together with an RPA-DWA analysis provide evidence for the T+1 isospin component of the isovector quadrupole giant resonance and for a new giant resonance, the spin monopole, both entered near Q/sub np/ = -21 MeV.

16896 Average resonance capture studies of /sup 102/Ru. Shi, Z.; Casten, R.F.; Stachel, J.; Bruce, A.M. (Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 435-438(15 Jan 1985). (CONF-840906—). Contract AC02-76CH00016.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

The /sup 102/Ru nucleus has been investigated via the ARC technique which ensures a complete set of J/sup π/ = 0^+, 1/sup +- /, 2/sup +- /, 3/sup +- /, 4/sup +- /, and 5^+ levels up to 2 MeV. The results are discussed in the framework of the IBA-1 with Consistent Q. The calculations show good agreement with the empirical data especially for the 0^+/sub /2 state, suggesting that it can be described in terms of collective degrees of freedom.

16897 Observation of extremely low s-wave strength in the reaction /sup 136/Xe+n. Fogelberg, B.; Harvey, J.; Mizumoto, M.; Raman, S. (Oak Ridge National Laboratory, Oak Ridge, TN 37831). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 493-494(15 Jan 1985). (CONF-840906—). Contract AC05-84OR21400.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Determination of the total cross section for the ^{136}Xe+n reaction from transmission measurements has been made. Thirty-five resonances were found in the 0-500 keV neutron energy range. Four very weak resonances may possibly be s-wave neutron interactions. (AIP)

16898 Decay scheme of /sup 116/Sn from (n,n',γ) and (n,γ) results. Gacsi, Z.; Sa, J.; Weil, J.L.; Jurney, E.T.; Raman, S. (University of Kentucky, Lexington, KY 40506). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 539-541(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

A decay scheme for /sup 116/Sn containing approximately 190 γ-rays and 112 levels below 6.0 MeV has been constructed by combining the results of /sup 116/Sn(n,n',γ) and /sup 115/Sn(n,γ) experiments.

16899 Direct measurement of natural line widths in delayed-neutron energy spectra. McElroy, R.D.; Clark, D.D.; Gill, R.L.; Piotrowski, A. (Ward Laboratory, Cornell University, Ithaca, NY 14853). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 912-915(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Delayed-neutron spectra of mass-separated fission products from the TRISTAN facility at Brookhaven are being investigated to develop systematics of neutron resonances in the 1—100 keV range in neutron-rich nuclides as a unique experimental basis for testing theoretical extrapolations of level parameters and neutron cross sections from stable to very unstable uclides. Aims, methods, and early results have been described elsewhere. The time-of-flight system yields resolved peaks, >10 between 3 and 100 keV in Rb-95 and Rb-97. Natural line widths have been deduced to date for two Rb-95 peaks: 414 +- 33 eV for the 14.44 +- 0.09 keV resonance and 670 +- 270 eV for the 26.70 +- 0.13 keV resonance, found by fitting the experimental data to a Lorentzian convoluted with a calculated system response function. Similar analysis of further peaks and deduction of level densities and other parameters await additional data from newly improved apparatus and planned experimental checks of the resolution calculation by measuring the Br-87 spectrum and comparing it with known resonance parameters of the Kr-86+n cross section.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

16900 **(DOE/ER/40048—202-L7) Systematic behavior of the giant dipole resonance in highly excited nuclei.** Gossett, C.A.; Behr, J.A.; Feldman, G.; Gundlach, J.H.; Kicinska-Habior, M.; Snover, K.A. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1987. Contract AC06-81ER40048. 8p. (CONF-8708101—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004162/JAW.

From 6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium (31 Aug 1987).

Study of the statistical decay of the giant dipole resonance (GDR) built on excited nuclear states provides information on nuclear properties at finite temperature and moderate spin. The results of a systematic investigation of GDR properties at high excitation covering a wide mass range, A ~40-170 will be presented. The observed resonance strengths and mean resonance energies vary smoothly as a function of mass and are in agreement with the properties of the ground-state GDR. The widths and resonance shapes of the GDR in highly excited nuclei reflect the deformation of the nucleus at finite temperature and spin. 13 refs., 6 figs.

16901 **(DOE/ER/40048—207-L7) Light-particle multiplicity accompanying projectile breakup at 20 MeV/A.** Vandenbosch, R.; Connolly, R.C.; Gil, S.; Leach, D.D.; Awes, T.C.; Sorensen, S.; Wu, C.Y. (Washington Univ., Seattle (USA); Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1987. Contract AC06-81ER40048;AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003487/JAW.

A large-solid-angle array has been used to determine the multiplicity of $Z = 1$ and $Z = 2$ particles accompanying projectile breakup into two fragments each with $5 \leq Z \leq 8$. The charge balance obtained shows that projectile breakup is not associated with an unusual charge transfer to the target. 13 refs., 1 fig.

16902 **(DOE/ER/40048—211-L7) Giant dipole resonances in hot nuclei.** Snover, K.A. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1987. Contract AC06-81ER40048. 17p. (CONF-871243—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004240/JAW.

From Symposium on hot nuclei; College Station, TX, USA (7 Dec 1987).

Reviewed are the properties of the giant dipole resonance in heated nuclei at moderate spin and temperature. Recent Seattle experiments and calculations are discussed, which emphasize angular distributions and the influence of deformation fluctuations on the GDR shape. 17 refs., 8 figs.

16903 (HMI—437, pp 7-21) **High-spin spectroscopy with OSIRIS.** Huebel, H. (Bonn Univ., Germany, F.R. Inst. fuer Strahlen- und Kernphysik). 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751499/JAW.

In Heavy ion physics at the VICKSI accelerator. A selection of research reports of external research groups.

As the first Compton-suppressed detectors arrived we have started a systematic investigation of /sup 160-166/Hf in order to study the alignments and band structures up to high spins. It was observed that this nucleus behaves like a perfect rigid rotor avobe spin 20. The high-spin states of the positive parity yrast band follow exactly the I(I+1)-rule E/sub I/ = AI(I+1)+BI/sup 2/ (I+1)/sup 2/ with B/A = 7 x 10/sup -6/. (orig./HSI).

16904 (HMI—437, pp 23-32) **Alpha- and beta-decay studies of neutron-deficient isotopes of tantalum and application for mass determination at the proton-drip line.** Schmidt-Ott, W.D.; Runte, E.; Hild, T.; Schrewe, U.J.; Tidemand-Petersson, P.; Micbaelsen, R. (Goettingen Univ., Germany, F.R.; Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H., Germany, F.R.). 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751499/JAW.

In Heavy ion physics at the VICKSI accelerator. A selection of research reports of external research groups.

The α-decays of /sup 162/Ta and /sup 163/Ta with E/sub α/ = 4.88(1), and 4.63(1) MeV, respectively, are reported. With these previously missing links two α-decay chains from /sup 179/Tl to /sup 147/Tb, and from /sup 174/Au to /sup 150m/Ho are completed. With the absolute masses of some N=82, and 83 isotones, masses and nucleon-binding energies far from β-stability were obtained and negative values of proton-separation energies derived for /sup 171/Ir, /sup 175/Au, and /sup 179/Tl. For /sup 160,161/Ta, half-life measurements were performed for the first time yielding 1.2(3), and 2.7(2) s, respectively. The half-lives of /sup 163,164/Ta were measured with improved accuracy to be 10.5(6), and 14.9(2) s, respectively. Initial results on the γ-decay of /sup 164/Ta are reported.

16905 (HMI—437, pp 61-72) **Orientation of the nuclear spin in heavy ion collisions at VICKSI energies.** Duennweber, W.; Hering, W. (Muenchen Univ., Germany, F.R. Sektion Physik). 1987. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751499/JAW.

In Heavy ion physics at the VICKSI accelerator. A selection of research reports of external research groups.

The spin transfer in /sup 20/Ne + /sup 168/Er collisions at an incident energy of 13.5 MeV/nucleon was object of a series of particle-γ coincidence experiments at HMI the results of which we summarize in this paper. (orig./HSI).

16906 (HMI—437, pp 45-59) **Dissipation of linear momentum and energy in fusion-like reactions.** Schroeder, W.U.; Birkelund, J.R.; Huizenga, J.R.; Tubbs, L.E.; Wilcke, W.W.; Bohne, W.; Gebauer, B.; Hilscher, D.; Holub, E.; Ingold, G. (Rochester Univ., NY, USA. Dept. of Chemistry and Physics; Rochester Univ., NY, USA. Nuclear Structure Research Lab.). 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751499/JAW.

In Heavy ion physics at the VICKSI accelerator. A selection of research reports of external research groups.

Experimental data are presented on the velocity distributions of fission fragments produced in 290-MeV /sup 20/Ne-induced reactions. The systematic dependence of complete fusion and linear-momentum transfer on bombarding energy is discussed in terms of a frictional model. In addition, spectra and angular distributions of energetic neutrons emitted in the /sup 165/Ho + /sup 12/C reaction at 25 MeV per nucleon are compared to Fermi jet calculations. Significant underestimation of the preequilibrium neutron intensity at angles perpendicular to the beam may indicate the importance of nucleonic two-body collisions.

16907 **(INIS-mf—10790) Angular momentum and isotope dependence of the deformation of residual nuclei in the rare earth region.** Muffler, R. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1986. 114p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751519/JAW.

The present thesis describes the measurement of α and proton anisotropies in the Darmstadt-Heidelberg crystal ball relative to the spin direction and in dependence on the prompt detector multiplicity for /sup 155,159,161/Ho compound nuclei from the fusion reactions /sup 37/Cl+/sup 124/Sn at 200 and 251 MeV incident energy, /sup 37/Cl+/sup 118/Sn at 251 MeV, as well as 173 MeV /sup 18/O+/sup 141/Pr. A novel and reliable procedure for the determination of the anisotropy is given which regards the broadening of the spin distribution by measurement of the E2-inertia ellipsoid at limited photon number as well as the statistical particle cascade on a purely experimental base. Only for the correction for "defects" of the crystal ball simulation calculations are necessary. The measured anisotropies are always and partially essentially smaller than those expected quantum mechanically and semiclassically expected for spherical nuclei. From a semiclassical analysis by Dossing/Neergard quadrupole deformation parameters vertical strokeδvertical stroke are obtained. The vertical strokeδvertical stroke-values are proved to be insensitive against different assumptions on the behaviour of the particle cascade.

16908 **(INIS-mf—10792) Study of angular momentum distributions in the range of the fusion barrier.** Heyng, H.W. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). Jan 1987. 109p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751521/JAW.

The reactions /sup 12/C -> /sup 150/Sm and /sup 80/Se -> /sup 82/Se were measured at energies of 53.4, 59.3, and 63.5 MeV respectively 257, 269.3, and 274.4 MeV. The final-nucleus distributions were identified via two Ge detectors additionally installed in the crystal ball by their characteristic transitions and the absolute fusion cross sections determined with a normalization to known Coulomb-excitation cross sections. The precise determination of the angular momentum distribution requires a detailed analysis of the measured data because many informations as for instance the anisotropy of the γ-quanta or the number of the statistical transitions must be regarded. The angular momentum distributions reconstructed from the analysis of the crystal ball data agree well with those deduced from the Ge spectra. Also in this fusion system the distributions of the single xn channels are narrower than predicted by the model calculations. However the total angular momentum distributions in the Er nuclei studied here except the reaction 53.4 MeV /sup 12/C -> /sup 150/Sm agree well with the calculations of the coupled channel theory and calculations with barrier fluctuations so that it seems to deal in the deviating results in the system /sup 156/Er with an effect of this special fusion system. For the 53.4 MeV /sup 12/C reaction both models predict too low angular momenta. The entrance-channel effect of the strong increasement (≈ 10%) of the 2n channel in the /sup 12/C-induced reactions observed also here can probably be explained by a /sup 8/Be transfer. A memory effect in the intensity ratio of neighbouring xn channels in dependence on the entrance channel could not be observed. (orig./HSI).

16909 **(INIS-mf—11018) Study of the $^{14}N + {}^{159}Tb$ reaction between 6 and 22 MeV/u.** Balster, G.J. (Rijksuniversiteit Groningen (Netherlands)). 6 Feb 1987. 257p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88700225/JAW.

The main topic of this thesis is the study of the dynamics of asymmetric nucleus-nucleus collisions from low to intermediate energies by concentrating on one specific reaction, $^{14}N + {}^{159}Tb$. The main experimental techniques involved are inclusive measurements and measurements of coincidences between particles and KX-rays. Additional experiments that were performed to support this study are also discussed. Results from measurements of target KX-ray production cross sections for heavy ion beams at energies above the Coulomb barrier are presented. It is shown that these cross sections can be accurately calculated and hence that the measurement of target KX-rays can serve as a convenient way of normalizing the particle-KX-ray coincidence data. Results from inclusive measurements of 92 MeV ^{14}N induced reactions on different targets are employed to investigate the reaction systematics at low energies. The systematic study of the $^{14}N + {}^{159}Tb$ reaction between 6 and 22 MeV/u via inclusive measurements and the measurement of particle-KX-ray coincidences is then presented. 411 references, 84 figures, 18 tables.

16910 (INIS-mf—11093, pp 10-11) **Shape coexistence and discrete-line superdeformed band in /sup 152/Dy.** Nyako, B.M.; Twin, P.J.; Nelson, A.H. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete; Daresbury Lab., UK). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

The very high spin states of /sup 152/Dy were studied, and a link between the observed superdeformed states and the other high spin spherical and oblate states was searched for. A new rotational band was discovered with almost constant moment of inertia of 58/MeV which coexists with the oblate particle-hole yrast states. The new band is interpreted as a four-quasiparticle configuration with small prolate deformation and triaxiality. A new discrete-line decay sequence of 19 transitions were also observed which is the first observation of a discrete-line superdeformed band. Some unexpected properties of the band open new theoretical questions. (D.Gy.). 4 refs.; 2 figs.

16911 (INIS-SU—431, pp 133) **Intensity measurement of the 84.26 keV γ-radiation in the /sup 170/Tm decay.** Gejdel'man, A.M.; Egorov, Yu.S.; Krylova, E.G.; Nedovesov, V.G.; Chereshkevich, Yu.L. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16912 **(IPNO-DRE—87-08) Shape coexistence in neutron-deficient mercury isotopes: /sup 187-188/Hg.** Bourgeois, C.; Hildingsson, L.; Jerrestam, D. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Jan 1987. 17p. (CONF-870153—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751740/JAW.

From 25. international winter meeting on nuclear physics; Bormio, Italy (19 Jan 1987).

The high-spin states of the /sup 187-188/Hg isotopes have been investigated via the /sup 164/ Dy(/sup 28/Si,xn) reactions by means of in-beam gamma-ray spectroscopy using the multidetector 4π-array "Chateau de Cristal" at the Strasbourg CRN laboratory. The level scheme have been established up to spin 45/2 in /sup 187/Hg and 24 in /sup 188/Hg. The various band structures are interpreted within the framework of the cranked shell model. For the first time in an odd-A mercury isotope, a prolate structure is found starting at very low energy and coexisting with the oblate structure based on the 13/2/sup +/ isomer. The hypothesis of a superdeformed structure in /sup 188/Hg in addition to the already known oblate and prolate shapes is conjectured.

16913 **(IPNO-DRE—87-19) High-spin excitations of /sup 187/Hg and /sup 188/Hg.** Hannachi, F.; Bastin, G.; Porquet, M.G.; Schueck, C.; Thibaud, J.P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751621/JAW.

High-spin states in /sup 187/Hg and /sup 188/Hg have been investigated via the /sup 163/Dy and /sup 164/Dy(/sup 28/Si,xn) reactions by in-beam γ-ray sepctroscopic techniques using the "Chateau de Cristal" 4π-multidetector array. Level schemes have been established. Spins and parities of the states have been deduced from transition multipolarities obtained from measurements of the angular distribution and linear polarization of the γ-rays. The shape coexistence of both prolate and oblate band structures has been observed for the first time in /sup 187/Hg. In /sup 188/Hg negative-parity bands are well developed. The band structure is interpreted within the frame of the Strutinsky method with the deformed Woods-Saxon average field. Pairing behaviour with increasing spin and general features of shape coexistence in mercury nuclei are illustrated.

16914 **(UCRL—96673-12/87) Shape isomers as candidates for the gamma ray laser storage state.** Weiss, M.S. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 14p. (CONF-880110—14). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005228/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

Three Dimension Nuclear Hartree-Fock calculations have been performed for isotopes of Osmium, Mercury, and Tungsten. Many of the calculated potential energy surfaces show a second minimum at large prolate deformation indicating the possibility of shape isomeric states. Several are at sufficiently low energy to be possible candidates as storage states for the gamma ray laser. 9 refs., 4 figs., 1 tab.

16915 **(UJV—7762-R) Calculation and preliminary analysis of group cross sections for gadolinium and its isotopes.** Holubar, A. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Aug 1986. 29p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700285/JAW.

Evaluated nuclear data files ENDL 78 and ENDF/B-IV and the cross section generation code FEDGROUP-R were used to produce averaged group cross sections for group systems BNAB and THSIG for gadolinium and its isotopes. Different sets of group cross sections for gadolinium (due to different evaluated data files or different processing codes) were compared and significant differences analyzed. The group capture cross sections for the isotopes of gadolinium were compared with published data. The group cross sections data sets prepared are analyzed as to what extent they can meet the requirements of cell calculations for gadolinium-loaded fuel. Some group cross section tables and cross section plots are presented.

16916 **Measurement of the nuclear level density at high spins.** Henss, S.; Ruckelshausen, A.; Fischer, R.D.; Kuehn, W.; Metag, V.; Novotny, R.; Janssens, R.V.F.; Khoo, T.L.; Habs, D.; Schwalm, D.; and others. (II. Physikalisches Institut, Universitaet Giessen, Giessen, West Germany). *Physical Review Letters;* **60**: No. 1, 11-13(4 Jan 1988).

The neutron spectrum from the reaction /sup 92/Zr(/sup 64/Ni, 1n)/sup 155/Er has been measured at an average spin of 52h-dash-bar and for excitation energies between 30 and 36 MeV in /sup 155/Er. Channel and spin selection have been obtained from the Darmstadt-Heidelberg crystal ball. The level density in /sup 155/Er is derived within the framework of a Fermi-gas model. A level-density parameter of a = [A/(8.8 +- 1.3)] MeV/sup -1/ is deduced.

16917 **Excitation energy division in the quasielastic region from reactions of 12 MeV/nucleon /sup 48/Ti with / sup 150/Nd.** Semkow, T.M.; Sarantites, D.G.; Honkanen, K.; Li, Z.; Ross, M.; Beene, J.R.; Halbert, M.L.; Hensley, D.C. (Department of Chemistry, Washington University, St. Louis, Missouri 63130). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 1, 169-177(Jan 1988).

Internal excitation of projectile-like fragments and target-like fragments was investigated for the system 12 MeV/nucleon /sup 48/Ti+ /sup 150/Nd, by measuring the discrete γ rays emitted by both fragments in coincidence with the charge-separated projectile-like fragments. Two quasielastic exit channels of the projectile-like fragments were studied: Z = 20 and Z = 22. Characteristic γ rays were used to determine the average masses of products, after separation and neutron evaporation, as a function of kinetic energy loss. Our results show that the mass-to-charge equilibration occurs quickly for the Z = 20 exit channel, but is slower for the Z = 22 channel. Comparison between the average masses of products with the masses calculated using the statistical model show that the excitation energy is divided approximately equally between the projectile-like and the target-like fragments for the Z = 20 exit channel. The excitation energy appears to be divided equally up to ~105 MeV of the kinetic energy loss corresponding to ~36% of kinetic energy damping. This result is consistent with predictions made by the stochastic nucleon-exchange models for a small kinetic energy loss.

16918 **Strength of deep-inelastic scattering for /sup 58/ Ni + /sup 124/Sn at sub-barrier energies.** Wolfs, F.L.H.; Henning, W.; Rehm, K.E.; Schiffer, J.P. (Argonne National Lab., USA; Chicago Univ., IL, USA). *Physics Letters [Section] B;* **196**: No. 2, 113-116(1 Oct 1987). Contract W-31-109-ENG-38.

Deep-inelastic scattering and fission yields have been measured for /sup 58/Ni + /sup 124/Sn at laboratory energies between 230 and 290 MeV. Even at energies below the Coulomb barrier, deep-inelastic scattering contributes significantly to the total reaction cross section and has a strength similar to that of fusion. Together with previous measurements, these results allow the complete decomposition of the total reaction cross section into its main components.

16919 **Evolution of nuclear structure with increasing spin and internal excitation energy in /sup 152/Dy.** Holzmann, R.; Ahmad, I.; Dichter, B.K.; Emling, H.; Janssens, R.V.F.; Khoo, T.L.; Ma, W.C.; Drigert, M.W.; Garg, U.; Radford, D.C. (Argonne National Lab., IL, USA; Notre Dame Univ., IN, USA; Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). *Physics Letters [Section] B;* **195**: No. 3, 321-325(10 Sep 1987). Contract W-31-109-ENG-38;AC02-76ER01672.

The total γ ray spectrum emitted by /sup 152/Dy has been measured in two different reactions and decomposed into its constituent parts. From the measured decay times, multiplicities, multipolarities and spectral shapes, the average decay path has been reconstructed. The yrast single-particle structures have been shown to give way to highly collective bands at internal excitation energies >1.5 MeV. A model, which takes into account the competition between statistical and collective decay at high spin and temperature, has been used to fit all features of the data, yielding Q/ sub t/ = 7.0/sub -1.5//sup +2.5/ eb for the collective bands.

16920 **Tests of supersymmetries with the (n,γ) reaction.** Warner, D.D. (Brookhaven National Laboratory, Upton, New York, 11973). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 247-261(15 Jan 1985). (CONF-840906—). Contract AC02-76CH00016.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

The characteristics of the SU(3) and O(6) beson-fermion symmetries stemming from a U(6/12) group structure are discussed and compared with recent results of (n,γ) studies in the W-Pt region. The nuclei /sup 185/W and /sup 195/Pt are shown to represent the best empirical examples of the SU(3) and O(6) limits, respectively, and it is also shown that the Consistent Q Formalism can be extended to the odd A Hamiltonian to describe the transition between these two limits. Preliminary comparisons with the low lying structure of the odd Os nuclei are presented. The question of the empirical evidence for supersymmetry in this region is also discussed.

16921 **M1-E2 mixing ratios of gamma-ground transitions in /sup 168/Er.** Gelletly, W.; Warner, D.D.; Colvin, G.C.; Schreckenbach, K. (University of Manchester, Manchester M13 9PL, U.K.). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 420-422(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

The L subshell ratios of four γ-g transitions in /sup 165/Er have been measured with the high resolution, iron, β-spectrometer at the Institut Laue-Langevin. The reduced M1-E2 mixing ratios are not consistent with the values predicted by Warner on the basis of IBA-1. It may be possible to explain the results in IBA-2 in terms of the ΔK-1 mixing of the gamma-band and the pure antisymmetric states such as the 1+ isovector mode.

16922 **Study of the low-lying states in /sup 178/Hf through the neutron capture reaction.** Haque, A.M.I.; Richter, R.; Gelberg, A.; Foerster, I.; Rascher, R.; von Brentano, P.; Boerner, H.G.; Schreckbench, K.; Kerr, S.A.; Barreau, G.; and others. (Institut fuer Kernphysik, Universitaet Koeln, FRG). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 423-426(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

The decay of the low-lying states of /sup 178/Hf was investigated using: (1) High-resolution curved crystal spectrometry of the secondary γ-rays using the GAMS-1 and GAMS 2/3 facilities at the ILL, (2) Measurements of the secondary (n,e$^-$) transitions using the Electron Spectrometer BILL at the ILL, (3) Measurements of the primary γ-transitions following thermal neutron capture with the pair-spectrometer at the ILL and (4) Average Resonance Capture (ARC) measurements at the neutron energies of 2 keV and 24 keV, using the tailored beam facilities at BNL.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

16923 **(CEA-CONF—9008) Coincident light fragments in heavy ion collisions: which are their partners.** Tomasi, E.; Charvet, J.L.; Bassini, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Jan 1987. 18p. (CEA-DPH-N-S—2445B; CONF-870153—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751332/JAW.

From 25. international winter meeting on nuclear physics; Bormio, Italy (19 Jan 1987).

In recent years, with the appearence of experimental facilities such as MSU, SARA and GANIL the study of reaction mechanisms has been extended at higher energies. At low energy deep inelastic collisions have been discovered and, increasing the incident energy, new mechanisms appeared, such as the sequential decay or the fragmentation of the projectile. A coincidence experiment was performed.

16924 **(CEA-CONF—9073) Collective flow in Ne + Pb collisions at E/A = 400 and 800 MeV.** Gosset, J.; Babinet, R.; De Marco, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Jun 1987. 6p. (CEA-DPH-N-S—2469B; CONF-8706233—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751548/JAW.

From International conference on intermediate energy nuclear physics; Balatonfured, Hungary (8 Jun 1987).

Triple differential cross sections in momentum p, polar angle θ, and azimuthal angle phi with respect to the reaction plane, have been measured at the Saturne synchrotron in Saclay for collisions between neon and lead nuclei.

16925 **(CEA-CONF—9074) Exclusive measurement of the Ne = Pb -> π /sup +-/, H, He at E/A = 400 and 800 MeV.** Poitou, J.; Babinet, R.; De Marco, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Jun 1987. 6p. (CEA-DPH-N-S—2469T; CONF-8706233—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751549/JAW.

From International conference on intermediate energy nuclear physics; Balatonfured, Hungary (8 Jun 1987).

This work is part of a systematic investigation of Ne-nucleus collisions undertaken with the 4 π detector Diogene. Only data obtained with Ne at 400 and 800 MeV/A on Pb nuclei are presented. Experimental data are also compared with the resuts of an intranuclear cascade calculation which takes, into account nuclear binding, Pauli blocking and isospin.

16926 **(CENBG—8704) Nuclear interferometry at backward angles with the use of a CsI hodoscope in /sup 16/O + /sup 197/Au at 93 MeV/A.** Goujdami, D.; Lautridou, P.; Quebert, J. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). Jan 1987. 18p. (CONF-870153—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751577/JAW.

From 25. international winter meeting on nuclear physics; Bormio, Italy (19 Jan 1987).

A small and compact hodoscope made of CsI scintillators was used to measure two-particle correlation functions at a large average angle (115 degrees) in /sup 16/O + /sup 197/Au at 93 MeV/A. The preliminary results are compared to those which are known either at lower energies or for different systems in collision. It is found that nuclear two-body interactions between the two detected particles are generally strongly attenuated. We interpret the results by considering a possible time ordering of emission in the deexcitation process.

16927 **(CONF-871243—2) Excitation and photon decay of giant resonances excited by intermediate energy heavy ions.** Bertrand, F.E.; Beene, J.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004171/JAW.

From Symposium on hot nuclei; College Station, TX, USA (7 Dec 1987).

Inelastic scattering of medium energy heavy ions provides very large cross sections and peak-to-continuum ratios for excitation of giant resonances. For energies above about 50 MeV/nucleon, giant resonances are excited primarily through Coulomb excitation, which is indifferent to isospin, thus providing a good probe for the study of isovector giant resonances. The extremely large cross sections available from heavy ion excitation permit the study of rare decay modes of the giant resonances. In particular, recent measurements have been made of the photon decay of giant resonances following excitation by 22 and 84 MeV/nucleon ^{17}O projectiles. The singles results at 84 MeV/nucleon yield peak cross sections for the isoscalar giant quadrupole resonance and the isovector giant dipole resonance of approximately 0.8 and 3 barns/sr, respectively. Data on the ground state decay of the isoscalar giant quadrupole and isovector giant dipole resonances are presented and compared with calculations. Decays to low-lying excited states are also discussed. Preliminary results from an experiment to isolate the ^{208}Pb isovector quadrupole resonance using its gamma decay are presented. 22 refs., 19 figs., 1 tab.

16928 **(GSI—87-52-Prepr.) Entropy in /sup 12/C + /sup 197/Au at intermediate energies.** Trockel, R.; Hildenbrand, K.D.; Lynen, U.; Mueller, W.F.J.; Rabe, H.J.; Sann, H.; Stelzer, H.; Trautmann, W.; Wada, R.; Eckert, E. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.); Muenster Univ. (Germany, F.R.)). Aug 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751498/JAW.

Isotopically resolved yields of complex particles and fragments from the reaction /sup 12/C on /sup 197/Au at three bombarding energies E/A = 30 MeV, 48 MeV, and 84 MeV were measured. Specific entropies S/A were derived from the isotope yield ratios using a quantum statistical model. The entropy increases with the bombarding energy in the case of preequilibrium light particles but, for intermediate mass fragments, has an energy independent value of S/A $\simeq$ 2.3.

16929 **(INIS-mf—11011) Shape coexistence and collective excitations in neutron-deficient even-mass Pb isotopes.** Penninga, J. (Vrije Univ., Amsterdam (Netherlands)). 3 Oct 1986. 104p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700218/JAW.

In this thesis a spectroscopic study is presented on the lead isotopes ^{192}Pb, ^{194}Pb and ^{196}Pb. These nuclei are far from the stability line and therefore very sensitive for fission which makes their production very difficult. Moreover the intruder states especially searched for in this study are very weakly excited in comparison with the yrast transitions. The experiments in this study were therefore very complicated as they were close to the detection limit of these states. In Chapter II a discussion is presented of the competition of fission with particle evaporation in neutron-deficient Pb nuclei at high excitation energy and angular momentum. Furthermore this chapter is devoted to the experimental methods and the used equipment in this study. Chapter III is focused on the structure of the even-mass Pb isotopes. In Chapters IV, V and VI the experimental results on the isotopes ^{196}Pb, ^{194}Pb and ^{192}Pb are presented and discussed. A summary of the results of this study can be found in Chapter VII. 54 references, 19 figures, 6 tables.

16930 **(IPNO-DRE—87-17) Forward angle measurements of 60 MeV/nucleon /sup 40/Ar peripheral interactions on /sup 208/Pb.** Suomijaervi, T.; Beaumel, D.; Blumenfeld, Y. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751611/JAW.

Velocity and angular distributions of projectile-like fragments were measured between θ/sub lab/ = O/sup 0/ and 4/sup 0/ (inside the grazing angle) for the /sup 40/Ar + /sup 208/Pb system at 60 MeV/nucleon using a magnetic spectrometer. Velocity spectra are similar to those obtained at larger angles while the angular distributions, very forward peaked for light nuclei, tend to become flat for the heaviest fragments. The influence of the Coulomb and nuclear deflection of the fragments is discussed.

16931 (PCCF-T—86-10) Production study of light fragments emitted at low angle in relativistic heavy ion collisions. Bastid, N. (Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire). Mar 1987. 244p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751856/JAW.

The Diogene plastic wall was built in order to study fragment production in a 0/sup O/-6/sup O/ angular range. After generalities on heavy ion collisions and a description of the Diogene detector, methods used for data analysis allowing identification of charged particles and measurement of their energy and emission angle are presented. From correlation studies between the Diogene events and the plastic wall events, we can have an information on the centrality of collisions. On the other hand, the study of differential cross sections shows two existing sources: one formed by the projectile remnant, at a velocity close to beam velocity and a source of intermediary rapidity formed by the participants. We have shown that even for very central collisions and heavy targets, the target nucleus remains partially transparent. In order to explain projectile fragmentation mechanism, we have used two models: a coalescence model and a thermal model. The first model gives the value of the coalescence radius. It seems that this model does not apply to angles nearing 0/sup O/. With the thermal model, we have been able to sort out apparent temperature values which confirm the weak excitation energy of the projectile remnant.

16932 Precision measurements of the K^- and Σ^- masses. Gall, K.P.; Austin, E.; Miller, J.P.; O'Brien, F.; Roberts, B.L.; Tieger, D.R.; Dodson, G.W.; Eckhause, M.; Ginkel, J.; Guss, P.P.; and others. (Boston University, Boston, Massachusetts 02215). *Physical Review Letters;* **60**: No. 3, 186-189(18 Jan 1988).

The masses of the K^- and Σ^- have been measured by use of exotic-atom x-ray transitions in Pb and W. The transitions used were free from contaminant nuclear γ rays and strong-interaction effects. Two K^- transitions and three Σ^- transitions for each target satisfied these criteria. The results are M/sub K//sub =/ = 493.636 +- 0.011 MeV and M/sub Σ//sub =/ = 1197.532 +- 0.057 MeV. The precision of these measurements is greater than that of any previous experiment. When combined with previous measurements they form a consistent set.

16933 Analysis of damped and fusion processes in the / sup 197/Au+/sup 51/V reaction at E/sub lab/ = 447 MeV. Schmieder, L.M.; Schroeder, W.U.; Butler, M.A. (Department of Chemistry and Nuclear Structure Research Laboratory, University of Rochester, Rochester, New York 14627). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 1, 139-157(Jan 1988).

Angular, energy, and Z distributions of projectile-like and fission fragments were measured for the reaction /sup 197/Au+ / sup 51/V at E/sub lab/ = 447 MeV. With increasing energy loss, the angular distribution evolves from a focused to an orbiting type, while the nearly Gaussian Z distributions broaden and drift to larger asymmetries. Extensive phenomenological analyses are presented for the angle-energy and charge-energy correlations. These data are compared in detail with results obtained from one-body transport model calculations. The effects of angular-momentum-dependent kinetic-energy fluctuations and of a reduced strength in the "wall friction" force are approximately taken into account. Good general agreement between data and model predictions is observed with friction forces of nominal strengths. The cross section for fusion-fission—like events, somewhat overestimated by the reaction model, is in reasonable agreement with the systematics provided by the "extra push" model parametrization.

16934 Charges and angular distributions of fast fragments produced in 3.2-TeV /sup 16/O collisions with Pb. Gerbier, G.; Williams, W.T.; Price, P.B.; Guoxiao, R.; Vanderhaeghe, G. (Physics Department, University of California, Berkeley, California 94720). *Physical Review Letters;* **59**: No. 22, 2535-2538(30 Nov 1987).

Out of 30 000 interactions of 3.2-TeV /sup 16/O nuclei in Pb, we found that no fast fragments had a charge $Z>8$, none with Zapprox. >5.5 had a charge that differed from an integer by as much as (1/3, and none with Zapprox. >5.5 had an angle to the beam >0.8 mrad. The cross section for production of a fast fragment with $Z>8$ or a stable particle with charge (19/3e, 20) / 3 e, (22/3e, or (23/3e is less than 240 μb at 90% confidence level. Using a measurement technique with a position resolution of 30 μrad, we found the transverse-momentum distributions for C, N, and O to be Gaussians with widths $\simeq$100 MeV/c, similar to those measured in projectile fragmentation of /sup 16/O at a factor 100 lower energy.

16935 E2/M1 mixing ratios in /sup 196/Pt from the / sup 195/Pt(n, γ)/sup 196/Pt reaction. Bruce, A.M.; Warner, D.D. (Schuster Lab., Univ. of Manchester, Manchester, M13 9PL, England). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 431-434(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Angular correlations in /sup 196/Pt have been measured using a new two detector correlation system at Brookhaven National Laboratory (BNL). The properties of /sup 196/Pt can be well described in terms of the O(6) limit of the IBA-1 formalism and the empirical determination of mixing ratios offers a further refinement to that comparison. The measured M1 components may provide information concerning the location of the isovector mode in the O(6) region. In addition, known correlations can provide a test of the new correlation system.

16936 Crystal ball studies of giant resonance gamma decay. Beene, J.R.; Bertrand, F.E.; Halbert, M.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 623-635(15 Jan 1985). (CONF-840906—). Contract AC05-84OR21400.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

We have carried out coincidence experiments to investigate the photon and neutron emission from the giant resonance region in /sup 208/Pb and /sup 90/Zr using the ORNL Spin Spectrometer, a 72-segment NaI detector system. States in /sup 208/Pb and ^{90}Zr were excited by inelastic scattering of 380-MeV ^{17}O. We have determined the total gamma-decay probability, the ground-state gamma branching ratio, and the branching ratios to a number of low-lying stats as a function of excitation energy in /sup 208/Pb to $\sim$15 MeV. Especially interesting observations include the absence of a significant branch from the giant quadrupole resonance to the 3^- state at 2.6 MeV, a strong branch from this resonance to a 3^- state at 4.9 MeV, and the dominance of decays to various 1^- states at 5—7 MeV from the region around 14 MeV of excitation (E0 resonances). Comparable but less complete data were also obtained on ^{90}Zr.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

16937 (INIS-SU—431, pp 319) Isomer ratio of the /sup 238/U(p,3n)/sup 236/Np reaction. Gromova, E.A.; Egorov, S.A.; Kovalenko, S.S. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16938 (ISN—87-49) On the longitudinal charge response in the quasi elastic peak region. Jaenicke, J.; Schuck, P.; Stroth, U.; Hasse, R.W. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Mar 1987. 3p. (CONF-8703153—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751408/JAW.

From International workshop on semi-classical and phase-space approaches to the dynamics of the nucleus; Aussois, France (16 Mar 1987).

We generalise our theory for the linear response function in the quasi elastic peak region to the case N not = Z and apply it to the recently measured e,e' cross-section of /sup 238/U. We find that the problem of the missing charge persists.

16939 (LYCEN—8702, pp S.7.1-S.7-5) **Study of subthreshold pion production for /sup 16/O induced reaction on /sup 232/Th AT 95 MeV/nucleon.** Erazmus, B.; Guet, C.; McGrath, R. (GANIL, 14-Caen, France). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Pions and protons emitted at 90/sup O/ were measured in coincidence with two fission fragments in the reaction /sup 16/O + /sup 232/Th at 95 MeV/nucleon. The average momentum transfer is 2.5 GeV/c for a pionic reaction and 2.2 GeV/c in the proton case. The data suggest that pion emission occurs over quite a broad range of impact parameters.

16940 **(RI—191) Energy spectrum of ^{253}Cf spontaneous fission prompt neutrons.** Blinov, M.V.; Bojkov, G.S.; Vitenko, V.A. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 51p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700282/JAW.

The spectrum of ^{253}Cf spontaneous fission prompt neutrons has been measured in the neutron energy range 0.01-10 MeV by the time-of-flight method using a fast ionization chamber with ^{235}U layers as a neutron detector. The numerical data and uncertainty file are presented. 29 references, 17 figures, 5 tables.

16941 **(SAND—86-2140) Natural gamma radiation from long-lived actinide isotopes.** Dupree, S.A.; Sanger, H.M. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004723/JAW.

The purpose of this report is to describe a method, developed at Sandia National Laboratories, for calculating volumetric, unshielded, gamma radiation source spectra with arbitrary energy group structures from essentially arbitrary mixtures of actinide isotopes. The computer code and data base are combined as INRAD. These spectra can be used to describe the source for gamma radiation transport codes. Coupled with this source routine is a special version of the one-dimensional, discrete ordinates, radiation transport code XSDRN that uses the spectrum generating routine to define sources in an appropriate energy group structure. 15 refs., 34 figs., 10 tabs.

16942 **(UCRL—97800) Conversion-electron experiment to characterize the decay of the ^{237}Np shape isomer.** Henry, E.A.; Becker, J.A.; Bauer, R.W.; Gardner, D.G.; Decman, D.J.; Meyer, R.A.; Roy, N.; Sale, K.E. (Lawrence Livermore National Lab., CA (USA)). 8 Dec 1987. Contract W-7405-ENG-48. 7p. (CONF-880110—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004402/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

Conversion electrons from the decay of low-lying levels of ^{237}Np have been measured to detect the population of these levels by gamma-ray decay of the ^{237}Np shape isomer. Analysis of the 208-keV transition L conversion-electron peak gives an upper limit of about 17 μb for the population of the 3/2$^-$ 267-keV level in ^{237}Np from the shape isomer decay. Model calculations are compared with the measured limit. Improvements are suggested for this experiment. 9 refs., 4 figs.

16943 **Energy dependence of the neutron multiplicity P/sub v/ in fast-neutron-induced fission for /sup 235,238/U and ^{238}Pu.** Zucker, M.S.; Holden, N.E. (Brookhaven National Lab., Upton, NY). *Transactions of the American Nuclear Society;* **52**: 636-638(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The behavior of P/sub v/ (the probability of v prompt neutrons being emitted in a fission) has not been well established as a function of (fast) neutron bombarding energy, even for the common and important nuclides ^{235}U, ^{236}U, and ^{239}Pu. The only applicable experimentally derived values for P/sub v/ we are aware of is from the French group Soleilhac et al. These data were never published, presumably because in its unedited form, as derived from analysis of relatively low event count rate experiments, it does not meet conventional standards for accuracy. Our task was to retrieve from this data set what is presumed to be a physically plausible, reasonably accurate representation of the P/sub v/ as a function of neutron energy E/sub n/.

16944 **High resolution studies of photofission of /sup 232/Th and /sup 238/U.** Zhang, H.X.; Lancman, H. (Brooklyn College, CUNY, Brooklyn, N.Y. 11210). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 241-246(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Photofission cross sections have been determined in several photon energy intervals with a photon energy resolution ~200 eV. The structure observed at 6.31 MeV in /sup 232/Th is interpreted as a reflection of class II compound states in this nucleus.

16945 **Coincidence electron scattering (e,e'f) and multipole strength functions in /sup 238/U.** Griffioen, K.A.; Countryman, P.J.; Knoepfle, K.T.; Van Bibber, K.; Yearian, M.R.; Woodworth, J.G.; Rowley, D.; Calarco, J.R. (Department of Physics and High Energy Physics Laboratory, Stanford University, Stanford, CA 94305). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 857-870(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

The inherent power of inelastic scattering to probe the nuclear response function in the nuclear continuum is completely exploited only in the coincident detection of decay products. The coincidence requirement effectively eliminates the strong elastic radiative tail which hitherto plagued the analysis of single arm (e,e') experiments. Large physical backgrounds (e.g. due to multistep processes as encountered in inelastic hadron scattering) are negligible due to the dominance of single photon exchange. Thus, coincidence electron scattering is a unique tool for quantitatively testing modern calculations of the nuclear response function. We have measured / sup 238/U(e,e'f) cross sections at three values of the momentum transfer (q≈0.26, 0.40, and 0.55 fm^{-1}, which correspond closely to the first maxima of the E1, E2/E0, and E3 form factors respectively) from below fission threshold to 23 MeV excitation energy. The angular correlations were measured at six or seven angles in each run. The data permit a clear multipole decomposition and a rigorous comparison with recent theoretical results from the Quasiparticle Random Phase Approximation (QRPA). The extracted E1 strength function agrees well with photofission results. The E2/E0 distribution displays prominent resonances at 10 and 13 MeV which suggest an identification with collective isoscalar E2 and E0 strength respectively, as predicted within the QRPA. However, the observed E2 strength is anomalously low, corroborating some earlier (α,α'f) reports. E2 and higher order multipoles contribute a sizable amount of strength in the region from 5 to 17 MeV.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 14454, 14718, 16319, 16357, 16622, 16625, 16656, 16698, 16699, 16700, 16706, 16707, 16707, 16765, 16775, 16777, 16778, 16785, 16786, 16793, 16795, 16805, 16843, 16854, 16854, 16867, 17389

16946 **(AERE-R—12419) Systematics of neutron-induced threshold reactions with charged products at about 14.5 MeV.** Forrest, R.A. (UKAEA Atomic Energy Research Establishment, Harwell. Nuclear Physics Div.). Dec 1986. 66p. H. M. Stationery Office, London, price Pound 6.00.

The reactions (n,p), (n,α), (n,np+pn+d), (n,t) and (n,h) at a 14.5 MeV are considered. Reaction cross section data up to 1985 are reviewed and compiled in the form of tables. These are used to test existing systematic formulae and to develop new formulae which can be used to predict unknown cross sections. The new formulae give fits to the data (by the method of weighted least squares) which are an improvement on existing systematics with the use of similar or fewer adjustable parameters. An estimate of the

error expected from the use of the systematics is given. Data on isomeric cross sections for these reactions are tabulated and an attempt is made to find a simple systematic formula for the isomer ratio. No satisfactory fit was found.

16947 **(BFMIRA-LG—22) Radioactivity - a layman's guide.** Wilson, L.G. (British Food Manufacturing Industries Research Association, Leatherhead). Jun 1986. 10p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. .

Price Pound 40.00.

The Guide has been written as a result of the many enquiries received by the Leatherhead Food R.A. from the food industry following the Chernobyl reactor accident in the U.S.S.R. It defines the terms used in discussions about radioactivity and explains the units of measurement employed in the assessment of its effects. Finally, it aims to put the effects of the Chernobyl accident in perspective to help the reader understand their significance.

16948 **(BNL—40548) Some thoughts on the muon-catalyzed fusion process for antimatter propulsion and for the production of high A mass numbers antinuclei.** Takahashi, Hiroshi. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 17p. (CONF-8710125—10). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005033/JAW.

From 2. review and planning workshop on antiproton science and technology; Santa Monica, CA, USA (6 Oct 1987).

The muon-catalyzed fusion process has a very valuable role for antiproton science and technology. Several schemes of propulsion energy enhancement of the antiproton-fueled propulsion using the muon-catalyzed fusion are discussed. Production of high A mass antinuclei by the muon-catalyzed fusion using the clustered antihydrogen molecule and quark-gluon plasma formation by annihilation of the produced high A antimatter with regular nuclei are discussed. 22 refs., 2 figs., 1 tab.

16949 **(CEA-CONF—8994) From multifragmentation of nuclei to the quark-gluon plasma.** Ngo, C.; Boisgard, R.; Desbois, J.; Nemeth, J.; Barranco, M.; Mathiot, J.F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Apr 1987. 18p. (CEA-DPH-N-S—2445; CONF-8704188—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751324/JAW.

From Symposium on central collisions and fragmentation processes; Denver, CO, USA (7 Apr 1987).

We apply a simple model, based on irrotational hydrodynamics and percolation, to study hot and compressed nuclei disassembly. We study the different conditions under which an excited nucleus breaks up into several pieces (multifragmentation). A simple percolation-aggregation model is also developed in order to calculate the conditions under which one can form a quark-gluon plasma. (Multifragmentation is one of the critical phenomena which are of a great present interest in heavy ion physics).

16950 **(CEA-CONF—9016) Equation of state and hydrodynamics of quark-gluon plasmas.** Ollitrault, J.Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Mar 1987. 8p. (CEA-SPhT—87-068; CONF-870390—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751537/JAW.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

A hydrodynamical model is used to describe the expansion of a quark-gluon plasma formed in the central rapidity region of a central heavy ion collision. We show that the correlations between multiplicities and average transverse momenta provide some information about the equation of state, and that these predictions are fairly universal, i.e. independent of the parameters used in the model.

16951 **(CEA-CONF—9018) Initial parton distributions in high energy nucleus-nucleus collisions.** Blaizot, J.P.; Mueller, A.H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Mar 1987. 5p. (CONF-870339—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751334/JAW.

From Moriond meeting on hadrons, quarks and gluons; Les Arcs, France (15 Mar 1987).

Simple criteria are proposed for characterizing the partons which are produced at the early stage of ultra-relativistic nucleus-nucleus collisions. These partons have an average transverse momentum which grows with the size of the colliding nuclei.

16952 **(CEA-CONF—9021) Nucleon in nuclei from quasi-elastic electron scattering.** Gerard, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Apr 1987. 12p. (CEA-DPH-N-S—2454B; CONF-8703136—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751336/JAW.

From Elementary structure of materials; Les Houches, France (24 Mar 1987).

One challenging problem in modern nuclear physics is to understand how the internal structure of the nucleon interferes with the dynamics of nucleons in a nucleus. The purpose of this paper is to review the present status of data in quasi-elastic electron scattering, to connect them with recent theoretical developments and to outline some future directions of research not accessible to present electron facilities.

16953 **(CEA-CONF—9024) Entrance channel influence on the formation and decay of hot nuclei.** Harar, S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie). Apr 1987. 19p. (CEA-DPH-N-S—2450B; CONF-8704188—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751339/JAW.

From Symposium on central collisions and fragmentation processes; Denver, CO, USA (7 Apr 1987).

Different entrance channels have been investigated to form very hot nuclei and to study their decay properties. i) Argon and Nickel projectiles accelerated around the Fermi energy show that central collisions induce momentum transfers to target nuclei which are proportional to the mass of the projectile and not to its velocities in the studied energy range. The preequilibrium model fits nicely the experimental results. The decay properties of the fission products for hot nuclei will be presented. Both head-on collisions and peripheral massive transfers contribute to the formation of very excited nuclei. The question of the influence of the energy deposit in the composite like system in limiting their yields is discussed. ii) Investigations have been also achieved with alpha projectiles at much higher incident energy (around 1 GeV/u). It is shown that hot and thermalized nuclei are also formed even when the nucleon-nucleon collisions are predominant. A sensitive parameter of the transition from binary fission to multifragmentation seems to be the energy deposit in the target residues rather than the projectile velocity.

16954 **(CEA-CONF—9040) Quark-gluon plasmas and collective features of nucleus-nucleus collisions at high energy.** Blaizot, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). May 1987. 10p. (CONF-8705195—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751540/JAW.

From International symposium on collective phenomena in nuclear and subnuclear long range interaction in nuclei; Bad Honnef, F.R. Germany (4 May 1987).

This paper reviews some aspects of the dynamics of the quark-gluon plasmas which may be produced in ultra-relativistic heavy ion collisions. A space-time description of the central rapidity region is presented. It is shown that the hydrodynamical flow induces correlations between particle transverse momenta and mul-

tiplicities. One discusses to which extent these correlations could signal the occurrence of a phase transition in heavy ion collisions.

16955 **(CEA-CONF—9088) Study of nuclear correlations and three-body forces with electrons.** Laget, J.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Jun 1987. 16p. (CEA-DPH-N-S—2462; CONF-8706200—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751552/JAW.

From CEBAF summer workshop; Newport News, VA, USA (22 Jun 1987).

While the study of these meson and Δ degrees of freedom in nuclei has been an important achievement of the last two decades, the major task of Nuclear Physics is now to go beyond and to study nuclei in kinematical regions where their effects are strongly suppressed or with probes to which they couple weakly. To day I will try to review the relevant experiments to be performed at a few Gev electron machines, and the problems raised by their analysis.

16956 **(CEA-CONF—9095) From Multifragmentation of nuclei to the quark gluon plasma.** Ngo, C.; Boisgard, R.; Desbois, J.; Cerruti, C.; Mathiot, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Jul 1987. 45p. (CEA-DPH-N-S—2461T; CONF-8706234—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751353/JAW.

From International school of physics Enrico Fermi: course on trends in nuclear physics; Varenna, Italy (23 Jun 1987).

Simple phenomenological approaches based on percolation have been applied to study the multifragmentation of nuclei and the formation of a quark-gluon plasma. In the first part, we briefly describe the experimental indications about multifragmentation of nuclei. We quickly review the results of a model based on irrotational hydrodynamics and percolation which allows to study hot and compressed nuclei disassembly. The formation of excited nuclei is then studied within the framework of a preequilibrium model proposed by Harp and Miller. We use this method, coupled to an isentropic expansion model and a percolation approach, to estimate incomplete fusion and multifragmentation cross sections of the Ar + Au system at intermediate bombarding energies. We also discuss the dependence of the multifragmentation threshold as a function of the mass asymmetry of the colliding system. In the second part of the lecture, we present a simple percolation-aggregation model to study the conditions under which a quark-gluon plasma can be formed. The method is also used to evaluate the proportion of multiquarks species in ordinary nuclear matter.

16957 **(CEA-CONF—9102) Microscopic description of nuclear shapes.** Bonche, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Jul 1987. 20p. (CEA-SPh-T—87-98; CONF-8706193—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751354/JAW.

From International conference on nuclear shapes; Crete, Greece (28 Jun 1987).

This talk describes recent three-dimensional self-consistent Hartree-Fock calculations. After an introduction providing the basic approximations and the different symmetries, we present an application to quadrupole deformation. We pursue with a study of octupole deformation properties of /sup 222/Ra and /sup 144/Ba nuclei for which states of good (positive and negative) parity are projected out. Finally we discuss an extension to the study of rotation and high-spin states with the cranked self-consistent Hartree-Fock method. As an example, the /sup 24/Mg nucleus is studied as a function of angular momentum from ground state up to fission.

16958 **(CENBG—8615) Theoretical approaches to the emission of α particles during nuclear fission.** Carjan, N. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). May 1986. 13p. (CONF-8605242—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751363/JAW.

From Seminar on fission; Habay la Neuve, Belgium (22 May 1986).

Recent models as well as new trajectory calculations used to interpret the experimental data on α-accompanied fission are presented and experimental hints towards the emission mechanism are pointed out. The important question of the distribution of the emission points and moments is brought up: are these particles coming only from the region between the fragments (the neck) or, are they coming with comparable probability, from any point of the surface of the fissioning system and: are they emitted just at scission or at any sufficiently deformed stage of the fission process. The simultaneous division of the nucleus into three fragments (the true ternary fission) is discussed in terms of the dynamical liquid-drop model. It is suggested that this process occurs in the tail (corresponding to overelongated shapes) of the distribution of the fission probability in the multidimensional space of the collective coordinates.

16959 **(CONF-871147—8) Dynamics of coupled electron-nucleon motion in a laser field.** Hartmann, F.X.; Garcia, K.K.; Munro, J.K. Jr.; Noid, D.W. (Institute for Defense Analyses, Alexandria, VA (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005063/JAW.

From 3. international laser science conference; Atlantic City, NJ, USA (1 Nov 1987).

Energy transfer processes in single particle coupled nucleon-electron models interacting with an intense laser field are studied using semi-classical quantization of the coupled classical Hamiltonian. 11 refs., 2 figs.

16960 **(CONF-871186—6) Description of evaluations for /sup 58,60,61,62,64/Ni performed for ENDF/B-VI.** Larson, D.C.; Hetrick, D.M.; Fu, C.Y. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002533/JAW.

From Meeting on the international nuclear data library for fusion reactor technology; Vienna, Austria (16 Nov 1987).

Isotopic evaluations for /sup 58,50,61,62,64/Ni performed for ENDF/B-VI are briefly reviewed. The evaluations are based on analysis of experimental data and results of model calculations which reproduce the experimental data. Evaluated data are given for neutron induced reaction cross sections, angular and energy distributions, and for gamma-ray production cross sections associated with the reactions. File 6 formats are used to represent energy-angle correlated data and recoil spectra. Uncertainty files are included for the major cross sections. Detailed evaluations are given for /sup 58/60/Ni, and results of calculations for the major reactions are used for evaluations of the minor isotopes. 29 refs., 8 figs.

16961 **(CONF-871243—4) A new look at reaction mechanisms with 4π charged-particle and neutron multiplicity measurements.** Sarantites, D.G.; Semkow, T.M.; Sobotka, L.G.; Abenante, V.; Li, Z.; Majka, Z.; Nicolis, N.G.; Stracener, D.W.; Hensley, D.C.; Beene, J.R. (Washington Univ., St. Louis, MO (USA). Dept. of Chemistry; Oak Ridge National Lab., TN (USA); Michigan Univ., Ann Arbor (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005058/JAW.

From Symposium on hot nuclei; College Station, TX, USA (7 Dec 1987).

We have studied the excitation of target-like fragments produced in the reactions of 331.9 MeV ^{28}Si + ^{181}Ta. The light charged particles and intermediate mass fragments were detected in a small, highly segmented 4π phoswich detector system placed inside the spin spectrometer, a 4π NaI array which served as a neutron and γ-ray detector. All target emissions indicate that excitation ceases to increase with decreasing projectile-like fragment energy, as it should if the primary reaction is binary. Non-equilibrium neutron, proton and α-particle emission and projectile fragmentation conspire and limit the conversion of kinetic energy into target excitation. This effect is more pronounced for PLF away from the injection point and for the largest kinetic energy losses. 8 refs., 10 figs.

16962 **(CONF-880147—1) The threshold anomaly for heavy-ion scattering.** Satchler, G.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004336/JAW.

From 11. symposium on nuclear physics; Oaxtepec, Mexico (4 Jan 1988).

The real parts of optical potentials deduced from heavy-ion scattering measurements become rapidly more attractive as the bombarding energy is reduced close to the top of the Coulomb barrier. This behavior is explained as a coupled-channels effect, and is related to the corresponding reduction in the absorptive potential through a dispersion relation which expresses the consequences of causality. Another manifestation of this "anomaly" is the striking enhancement observed for the near- and sub-barrier fusion of two heavy ions. The barrier penetration model of fusion is examined critically in this context. It is also stressed that similar anomalies could appear in the energy dependence of nonelastic scattering. 21 refs., 4 figs.

16963 **(CONF-8706149—2) Present status of the theory of πNN systems.** Mizutani, T. (Virginia Univ., Charlottesville (USA). Dept. of Physics). 1987. Contract FG05-84ER40143. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003488/JAW.

From International conference on the theory of few body and quark-hadronic systems; Dubna, USSR (16 Jun 1987).

In the present discussion the existing data are compared with various model calculations within the πNN theory to assess the appropriateness of the latter. Globally the models in their present form reproduce the data quite well in view of the number of channels in which the comparison was made. From the quantitative point of view the models must be upgraded in several different ingredients. First, it is the parameters of the NN heavy meson exchange potentials when combined with the explicit pion and nucleon isobar degrees of freedom. A right choice of their values will lead to a better account of such observables like the beam asymmetries and vector analyzing power in a number of channels like NN in equilibrium πd, NN $\rightarrow$ πNN, etc. The next one may be the model for the Δ resonance (or the πN P_{33} off-shell amplitude). A simple monopole or dipole form factor for the $\pi N\Delta$ vertex had difficulty in reproducing the major NN partial wave phase parameters. In view of the fact that $d\sigma/d\Omega$ for the deuteron photodisintegration in the Δ resonance region cannot be explained at all by the coupled NN-NΔ model, one should seriously consider a better model for the Δ. 39 refs., 10 figs.

16964 **(DOE/ER/40048—212-L7) The giant dipole resonance at modern temperature and spin.** Snover, K.A. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1987. Contract AC06-81ER40048. 15p. (CONF-8709200—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004239/JAW.

From 1. topical meeting on giant resonance excitation in heavy-ion collisions; Legnaro, Italy (21 Sep 1987).

The properties of the giant dipole resonance in heated nuclei at moderate spin and temperature are discussed, with emphasis on recent Seattle measurements and calculations. These new results emphasize the role of deformation fluctuations in determining the GDR shape. 17 refs., 8 figs.

16965 **(DOE/ER/40143—4-Rev.) Theoretical studies in few-body intermediate energy physics: Progress report, December 1, 1986-November 30, 1987.** Mizutani, T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Physics). Nov 1987. Contract FG05-84ER40143. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004101/JAW.

This paper discusses progress in the following areas: coupled πNN-NN system, low energy NN/bar/ interactions, and K-d interactions. 4 refs. (LSP)

16966 **(DOE/ER/40224—54) Enhanced multiplicity fluctuation as a possible signature of quark matter.** Hwa, R.C. (Oregon Univ., Eugene (USA)). Oct 1987. Contract FG06-85ER40224. 9p. (CONF-8708202—2; OITS—371). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004545/JAW.

From Quark matter '87: 6th international conference on ultra-relativistic nucleus-nucleus collisions; Schloss Nordkirchen, F.R. Germany (1 Aug 1987).

In nucleus-nucleus collisions at very high energy the possibility that an enhancement in the multiplicity fluctuation may signify the formation of a quark-gluon plasma is suggested. The optimal procedure in finding the signature is discussed. Both hydrodynamical and statistical descriptions of the dependences on rapidity intervals are examined. A simple model that simulates hadronization during phase transition from quark matter to hadron gas is presented. In that model the dispersion in multiplicities is shown to become very large. 11 refs.

16967 **(DOE/ER/40343—1) Research in experimental nuclear physics: Progress report, April 1, 1987-March 31, 1988.** Moore, C.F. (Texas Univ., Austin (USA). Dept. of Physics). Nov 1987. Contract FG05-87ER40343. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004100/JAW.

The research activities discussed in this paper involve experiments done with the Energetic Pion Channel and Spectrometer (EPICS), the Low Energy Pion Channel (LEP), the Pion Particle Physics Channel (P^3), the High Resolution Spectrometer (HRS).

16968 **(GANIL-P—86-20) Light nuclei far from stability: limits and properties.** Detraz, C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Aug 1986. 14p. (CONF-860802—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751855/JAW.

From International nuclear physics conference; Harrogate, UK (25 Aug 1986).

Why and how to study light exotic nuclei is first presented. Then the search for new radioactivities is reviewed, and the method developed at Ganil to have absolute measurement of the nuclear mass with a convenient uncertainty. Other quantitative information on exotic nuclei are finally recalled.

16969 **(GSI—87-14) Transport phenomena in dissipative heavy-ion collisions. The one-body dissipation approach.** Feldmeier, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Aug 1987. 171p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751496/JAW.

The discovery of dissipative collisions between two atomic nuclei opened a new field of research in nuclear physics. Before that thermodynamic argumentation was infrequent and nonequilibrium statistical physics was absent in the scattering theory for atomic nuclei. The theory of nuclear physics was mainly written in terms of pure quantum states. The general acceptance of concepts like friction and diffusion took some time because the textbook arguments for a statistical treatment seem to be not applicable. Neither is the number of partaking constituents very large nor is the identification of the macroscopic variables evident, and the absence of a heat bath did not allow to use conventional nonequilibrium physics where the response of the subsystem to small deviations from equilibrium is studied. Nevertheless, the highly incomplete experimental measurements showed clearly a dissipative behaviour in observables like energy, scattering angle, mass and charge number. The collected data resemble the actions observed in Brownian movement but the fluctuations are much larger than expected from Einstein's relation between friction and diffusion. As the study of Brownian movement is the key to the understanding of all dissipative phenomena we use it to introduce the concepts which we then make use of in a specific dissipative model. We discuss the "One-body Dissipation model" in its richness of phenomena and compare its predictions to measured data. Special attention is paid to the nonequilibrium relation between friction (or mobility) and diffusion.

16970 (GSI—87-53-Prepr.) Dynamical evolution of the mass asymmetry and the extra-extra push. Feldmeier, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Aug 1987. 9p. (CONF-8611214—). Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

From 16. international symposium on nuclear physics - dynamics of heavy ion collisions; Gaussig, German D.R. (10 Nov 1986).

Within the framework of the one-body dissipation model we investigate the role of the dynamics in the mass asymmetry degree of freedom in heavy-ion collisions. In the following we discuss the results calculated for head on collisions in a liquid drop idealization. This model treats the dynamical evolution of three shape degrees of freedom which describe a family of axially symmetric nuclear shapes with fixed volume. The shapes consist of two generally unequal spheres modified by a smoothly fitted portion of a third quadratic surface of revolution. (orig./HSI).

16971 (IAE—4241/2) Change of the M2+E3 (Planck constantω=2.38+-0.36 keV) conversion transition rate in / sup 90m/Nb isomer at variations of atomic shell valence zone configuration. Grechukhin, D.P.; Soldatov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700173/JAW.

Conversion process of mixed (M2+E3)-transition of /sup 90m/Nb (Planck constantω=2.38+-0.36 keV) is studied in detail. Changes in δλλ isomer decay rate depending on the atom chemical surrounding and effect of the threshold mechanism are considered. The structure of valence zone in the atom shell is varied in the class of configurations (4d)*(5s)/sup y/(5p)/sup 5-x-y/, where 0≤x≤5; 0≤y≤2. Another aim of the work is to evaluate nuclear matrix elements of M2- and E3-multipoles for isomeric transition of /sup 90m/Nb_{41} and subsequent interpretation of the elements in the framework of the shell model. 18 references, 4 figures, 9 tables.

16972 (IN2P3—86-01) Symmetries and nuclear physics. Depommier, P.; Gales, S.; Nguyen van Giai (eds.). (Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France)). 1986. 538p. (In French). (CONF-8609338—). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751391/JAW.

From Joliot Curie school of nuclear physic: symmetries and nuclear physics; Maubuisson, France (15 Sep 1986).

Symmetries, their breaking and their restauration are the subject of this school: eight lectures are been abstracted and indexed.

16973 (IN2P3—86-01, pp 137-259) Isospin symmetry and nuclear structure. Gales, S.; Van Giai, N. (Paris-11 Univ., 91 - Orsay, France. Institut de Physique Nucleaire). 1986. (In French). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751391/JAW. (CONF-8609338—).

From Joliot Curie school of nuclear physic: symmetries and nuclear physics; Maubuisson, France (15 Sep 1986).

The main effects of the approximate isospin invariance in nuclear systems are reviewed. After a short reminder of isospin formalism, experimental evidences from the two-body problem and concerning charge invariance and charge symmetry of nuclear forces are examined. Various theoretical predictions of isospin impurity in nuclear states are compared. The usefulness of isospin is illustrated by the extraction of the weak coupling constant G/sub V/ from superallowed β transitions. The isobaric multiplet mass formula and the forbidden decays are studied in detail experimentally as well as theoretically. Experimental aspects of isobaric analog resonances are presented, and their interpretation is made in the framework of microscopic models. The problem of Coulomb displacement energies is examined, especially for the case of mirror pairs. Finally, the role of isospin symmetry in intermediate energy reactions leading to giant resonances (charge exchange isovector resonances, Gamow-Teller resonances, Ml, etc...) is studied.

16974 (IN2P3—86-01, pp 365-414) Introduction to interacting boson model. Goutte, D. (CEA CEN Saclay, 91 - Gif-sur-Yvette, France. Service de Physique Nucleaire a Haute Energie). 1986. (In French). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751391/JAW. (CONF-8609338—).

From Joliot Curie school of nuclear physic: symmetries and nuclear physics; Maubuisson, France (15 Sep 1986).

A very simple presentation of the interacting boson model is first given. The two computerized models which are presented allow, with few parameters, to reproduce an impressive quantity of data characterizing the deformed nuclei. Their excitation spectra, the reduced transition probabilities, the quadrupolar moments, the two nucleon transfer experiment results, ... Then a specific application of the model is given: radial extension reproduction of nuclear functions. It is shown first how the electron inelastic scattering allows to measure observables related to these radial functions, the transition charge densities, then, on some examples, how the model allows to reproduce them.

16975 (IN2P3—86-01, pp 415-444) Odd A nuclei description in terms of boson and fermion interacting model. Vergnes, M. (Paris-11 Univ., 91 - Orsay, France. Inst. de Physique Nucleaire). 1986. (In French). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751391/JAW. (CONF-8609338—).

From Joliot Curie school of nuclear physic: symmetries and nuclear physics; Maubuisson, France (15 Sep 1986).

The odd-A nuclei are considered in the IBFM model to consist of an even-even core (described by the interacting boson model) and of a few fermions. In the general case the Hamiltonian is numerically diagonalized after a number of approximations. The results of a typical calculation are compared to experiment. In special cases it is possible to obtain analytical expressions for experimentally measurable quantities. These limiting cases are the Bose-Fermi symmetries for odd-A nuclei and the supersymmetries describing simultaneously both even-even and odd-A nuclei. The Bose-Fermi Spin (6) and the U(6/4) supersymmetry models are described in details and compared to experiments. The more recent "multi-j" U(6/12) supersymmetry models, the extension of supersymmetry to the odd-odd nuclei and the generalized supersymmetry, are only briefly discussed.

16976 (IN2P3—86-03, pp 269-316) Experimental viewpoints of heavy ion collisions: quark and gluon plasma. London, G.W. (CEA CEN Saclay, 91 - Gif-sur-Yvette, France. Dept. de Phys. des Particules Elementaires). 1986. (In French). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751392/JAW. (CONF-8409260—).

From CERN accelerator school; Gif-sur-Yvette, France (3 Sep 1984).

Only in ultra-relativistic nucleus-nucleus collisions can extended regions of nuclear matter with high energy densities be produced under laboratory conditions. Even if there were no exciting expectations (the quark-gluon plasma), these new extreme conditions are reason enough to perform an experimental program. The minimum aim of this program should be to investigate these extreme and complex experimental conditions in order to isolate new physical processes. This modest approach is necessitated by the fact that we have only qualitative guides for the probes of the phase transition between ordinary hadronic matter and quark matter. In this article, we describe the expected high energy nucleus-nucleus environment. Possible signatures of the quark-gluon plasma are described. In order to observe a new process, one must vary the energy density; various methods are suggested. Finally, future experimental programs, especially at the CERN-SPS, are summarized.

16977 (INIS-mf—11005) Meson-exchange forces and medium polarization in finite nuclei. Hengeveld, W. (Vrije Univ., Amsterdam (Netherlands)). 1 May 1986. 113p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700212/JAW.

A G-matrix, derived from a meson-exchange potential in nuclear matter, is applied to finite, semi-magic nuclei. For the open shell the broken-pair model, which can accomodate many particle levels, is used. The excitations of the closed shell are treated as par-

ticle-hole states. Energy spectra and electromagnetic transition densities are calculated for ^{86}Sr and ^{58}Ni. The standard random-phase approximation for finite systems is extended by including the effects of the exchange of the RPA phonons in the residual interaction selfconsistently. It is shown that this particle-hole interaction is strongly energy dependent due to the presence of poles corresponding to 2p-2h (and more complex) excitations. The RPA eigenvalue problem with this energy-dependent residual interaction also provides solutions for these predominantly 2p2h-like states. In addition a modified normalization condition is obtained. This scheme is applied to ^{56}Ni(^{56}Co) in a large configuration space using a residual interaction of the G-matrix type. The effect of dynamic medium polarization on the properties of giant resonances is illustrated for the case of A=48 nuclei. A large fragmentation of the monopole strength is calculated, which is in accordance with the non-observation of the GMR in light nuclei. Properties of A=48 nuclei are computed with an interaction deduced from the NN scattering data without introduction of additional parameters. The role of medium polarization is illustrated for spectra and (e,e') form factors. It is shown how medium polarization induces a coupling between excitations in even-even and in the adjacent odd-odd nuclei.

16978 (INIS-mf—11015) **Microscopic foundation and geometric interpretation of the interacting-boson model.** Walet, N.R. (Rijksuniversiteit Utrecht (Netherlands)). 4 Mar 1987. 153p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700222/JAW.

A number of aspects of the relation between the shell model and the interacting-boson model are studied. The IBM is assumed to describe that part of the shell-model space where all states are built from selected, correlated pairs with angular momentum zero or two, which are mapped onto bosons. The goal of a microscopic derivation of IBM is to determine this subspace and to obtain the parameters that govern the dynamics in boson space. A formalism is introduced to calculate the expectation value of the hamiltonian between states containing such correlated fermion pairs. This formalism only applies to spherical nuclei, where zero-coupled pairs dominate. It is applied to the semimagic tin nuclei. Several methods are compared to determine the structure of the collective pairs in order to find a method which gives the best pairs. The formalism is also applied to the mercury isotopes for which both neutrons and protons are active. In this more realistic case the above-mentioned methods to determine the pairs are also studied. The IBM-2 parameters are derived from the microscopic calculation. Group-theoretical aspects of the SU(3) limits of IBM-1 and IBM-2 are investigated. A complete decomposition for the SU(3) limits is given. Specific attention is paid to the triaxial-rotor SU(3)*-limit, which is thought to describe nuclei with a triaxial shape. The SU(3)* symmetry of IBM-2 is applied in a study of the ^{192}Os nucleus. The relation between IBM and geometrical models is discussed. 106 references, 33 figures, 10 tables.

16979 (INIS-mf—11093, pp 18-20) **Applications of the breathing cluster model.** Lovas, R.G.; Kruppa, A.T.; Beck, R.; Dickmann, F. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete; Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R.). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

The cluster model of nuclei was worked out in detail for spherical symmetry, i.e., when the possible excitations are s waves, breathing like ones. The applications of the model are surveyed. For the characterization of the clustering a parameter was introduced which measures the projection of the nuclear state onto the cluster subspace. The measurability of the clustering parameter is also discussed. Some results are presented on the light, two-cluster nuclei where the agreement of theory and experiment is very good. (D.Gy.). 8 refs.; 2 figs.

16980 (INIS-mf—11093, pp 23-25) **Supersymmetry and quark effects in nuclear structure.** Arvay, Z. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

16981 (INIS-mf—11093, pp 21-22) **Studies based on the analogy between collective p-p and p-h excitations. Giant resonances; Macroscopic form-factors for 2-particle transfer.** Herzog, M.W.; Liotta, R.J.; Civitarese, O.; Ferreira, L.S.; Sibanda, L.J.; Vertse, T.; Dragun, O. (Research Inst. of Physics, Stockholm, Sweden; La Plata Univ. Nacional, Argentina. Dept. de Fisica; Coimbra Univ., Portugal; Royal Inst. of Tech., Stockholm, Sweden. Dept. of Theoretical Physics; Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete; Comision Nacional de Energia Atomica, Buenos Aires, Argentina. Dept. de Fisica). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780040/JAW.

In ATOMKI Annual Report 1986.

16982 (INIS-SU—428, pp 46-52) **Effect of nucleus shape oscillations on the subbarrier fusion cross section.** Dzholos, R.V.; Permyakov, V.P. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Theoretical Physics). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780044/JAW. (JINR-N—1[21]-87).

In JINR rapid communications. Collection.

A method is proposed for calculating nonadiabatic corrections to a nucleus-nucleus potential in the reaction input channel caused by the Coulomb interaction of nuclei. It is shown that the Coulomb turning point (at a fixed collision energy) shifts to the left, which narrows the potential barrier defining the channel efficiency of a subbarrier fusion of nuclei. This results in the growth of cross sections of subbarrier fusion of complex nuclei observed experimentally. 12 refs.; 2 figs.

16983 (INIS-SU—431, pp 182) **Calculation of multipole giant resonance strength functions in semimicroscopic oscillation model with account of continuous spectra.** Gol'tsov, A.N.; Orlin, V.N.; Sapunenko, V.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16984 (INIS-SU—431, pp 187) **Quartets of /sup 190,191/Os, /sup 191,192/Ir and /sup 192,193/Os, /sup 193,194/Ir nuclei according to the U(6/6ν+12π) supersymmetric scheme in SU(3) limit.** Ruzha, Ya.Kh.; Guseva, T.V.; Tamberg, Yu.Ya.; Balodis, M.K. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16985 (INIS-SU—431, pp 191) **Approximately relativistic theory of a nucleus. 1.** Krutov, V.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16986 (INIS-SU—431, pp 192) **Approximately-relativistic theory of a nucleus. 2.** Krutov, V.A.; Krutova, L.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16987 (INIS-SU—431, pp 195) **On description of 2/sup +/ and 3/sup -/ collective states of even-even nuclei.** Krygin, G.B.; Mitroshin, V.E.; Fisenko, I.G. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16988 (INIS-SU—431, pp 202) **Interaction of negative parity phonons with core quadrupole excitations.** Dojnikov, D.N.; Mikhajlov, V.M. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16989 (INIS-SU—431, pp 205) **Structure of states of samarium even-even isotopes in the interacting boson model.** Baktybaev, K.B.; Ramankulov, K.E.; Strygin, D.P. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16990 (INIS-SU—431, pp 234) **Analysis of irregular M1(E1)-transitions.** Feresin, A.P. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16991 (INIS-SU—431, pp 235) **On corrections to radiative and conversion transitions in the single-particle model.** Feresin, A.P. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16992 (INIS-SU—431, pp 468) **Study on an evaporation of light particles from deformed nuclei by Monte Carlo method.** Aleshin, V.P. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16993 (INIS-SU—431, pp 476) **Polarization of γ quanta in excitation of /sup 16/O nucleus 6.13(3/sup -/) MeV energy level by polarized neutrons.** Lifshits, E.P. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16994 (INIS-SU—431, pp 259) **Toroidal moments in muon conversion.** Lavrenov, A.N.; Shchulyakovskij, G.S. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16995 (INIS-SU—431, pp 325) **Population of magnetic sublevels of 2/sup +/ state in /sup 12/C nucleus.** Balashova, O.Yu.; Zelenskaya, N.S.; Ovchinnikova, A.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16996 (INIS-SU—431, pp 324) **Characteristic calculation of spin sublevels of 2/sup +/ level in /sup 12/C nucleus.** Balashova, O.Yu.; Zelenskaya, N.S.; Ovchinnikova, A.A.; Teplov, I.B. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16997 (INIS-SU—431, pp 456) **Description of hadron-hadron interaction in the framework of the generalized R matrix formalism.** Babenko, V.A.; Petrov, N.M. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16998 (INIS-SU—431, pp 183) **Discrete symmetry of bound and virtual levels in the Woods-Saxon potential.** Orlov, Yu.V.; Nikitina, L.I. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

16999 (INIS-SU—431, pp 232) **Inverse bremsstrahlung of polarized electrons with account of recoil effects and nuclear structure.** Nadzhafov, I.M.; Rustamova, G.R. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17000 (INIS-SU—431, pp 462) **Regularities of massive transfer direct processes in heavy ion reactions.** Zagrebaev, V.I.; Kozhin, A.Yu. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17001 (INIS-SU—431, pp 463) **Statistical distribution of S matrix element phases of the compound-nucleus reaction in the range of isolated and overlapping resonances.** Senyuk, Yu.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17002 (INIS-SU—431, pp 464) **Direct mechanisms of stripping and heavy replacement in an interaction of lithium and nitrogen ions with /sup 12/C nucleus.** Belyaeva, T.L.; Zelenskaya, N.S. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17003 (INIS-SU—431, pp 465) **Statistical correlation of analyzing power and cross sections in the /sup 26/Mg(p,p) and /sup 28/Si(p,p) scattering.** Kun, S.Yu. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17004 (INIS-SU—431, pp 466) **Classical fluctuation peculiarities and the time decay law in deep inelastic heavy ion collisions.** Kun, S.Yu. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17005 (INIS-SU—431, pp 469) **Method of intranuclear cascade, diffraction approximation and multistage direct processes.** Bunakov, V.E.; Matveev, G.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17006 (INIS-SU—431, pp 471) **Description of E-resonance decay characteristics of /sup 12/C, /sup 24/Mg, /sup 26/Mg nuclei with account of fragmentation processes of particle and hole states in the continuum model.** Gol'tsov, A.N.; Orlin, V.N.; Sapunchenko, V.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17007 (INIS-SU—431, pp 473) **Inclusive direct nuclear reactions.** Kadmenskij, V.G.; Kadmenskij, S.G.; Luk'yanovich, P.A.; Rudchik, A.T. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17008 (INIS-SU—431, pp 475) **One-particle Green function for a particle in absorbing matter.** Bunakov, V.E.; Kadmenskij, S.G. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17009 (INIS-SU—431, pp 477) **Analysis of neutron evaporation spectra as a method of determination of nucleus ground state correlation functions.** Svirin, M.I.; Smirenkin, G.N. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17010 (INIS-SU—431, pp 478) **Theoretical analysis of the (e,e'N) and (γ,N) reactions on /sup 16/O.** Dmitriev, V.F.; Telitsyn, V.B. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17011 (INIS-SU—431, pp 479) **On a slope of subthreshold π-meson spectra.** Zubkov, M.D.; Pozdnyakov, A.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17012 (INIS-SU—431, pp 480) **On coherent mechanism of subthreshold pion production in heavy ion collisions.** D'yachenko, A.T. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17013 (INIS-SU—431, pp 484) **Dispersion theory of direct nuclear neutron-transfer reactions by heavy ions.** Kayumov, Sh.S.; Mukhamedzhanov, A.M.; Yarmukhamedov, R. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

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17050 (INIS-SU—431, pp 455) **Role of (p,n) recharge in the /sup 6/Li(p,nd)/sup 4/Li/sup */ reaction of fast deuteron quasi-elastic knock-out.** Zhusupov, M.A.; Imambekov, O.; Uzikov, Yu.N. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

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17054 (INIS-SU—431, pp 217) **Binding energies and nucleus stability of transfermium region.** Kolesnikov, N.N. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

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17055 (INIS-SU—431, pp 467) **On relation of inclusive particle energy spectra in three-particle decay of neutron- and proton-overriched light.** Danilin, E.V.; Zhukov, M.V.; Korsheninnikov, A.A.; Chulkov, L.V.; Ehfros, V.D. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

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17059 (INIS-SU—431, pp 419) **Cluster radioactivity - advances and promises.** Tret'yakova, S.P.; Furman, V.I.; Mikheeva, V.L.; Chuvil'skij, Yu.M.; Kadmenskij, S.G. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

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17060 (INIS-SU—431, pp 472) **Fast fission nuclei and critical radius.** Dobromyslov, M.B. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

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17061 (INIS-SU—431, pp 483) **Analysis of prompt neutron spectrum of /sup 252/Cf(sf) fission on the basis of the thermodynamic model.** Grashin, A.F.; Lepeshkin, M.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

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17062 (INIS-SU—431, pp 495) **Influence of pre-equilibrium neutron emission on duration of the /sup 238/U(d,f) reaction.** Grusha, O.V.; Khajmin, V.A.; Yuminov, O.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17063 (INS—640) **Hypernucleus formation in high-energy nuclear collisions.** Wakai, M.; Bando, H.; Sano, M. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Aug 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751967/JAW.

A coalescence model is used to estimate the hypernucleus formation probability in nuclear collisions. The formation cross section is calculated for p + Ne and Ne + Ne systems at 2.1 GeV/nucleon and 5 GeV/nucleon. It is shown that the probability of the hypernucleus production at 5 GeV/nucleon becomes about a few times larger than at 2.1 GeV/nucleon and also the hypernucleus production cross section in the Ne-Ne collisions becomes approximately a few times the cross section in the p-Ne collisions. The Λ hypernucleus cross section is of the order of magnitude of μb in the Ne-Ne collisions at 5 GeV/nucleon and an increase of one Λ-particle in a hypernucleus reduces the cross section by a factor of about 10/sup 5/.

17064 (INS—644) **Enhanced superconductive interaction by antiferromagnetic spin waves.** Sogo, Kiyoshi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751970/JAW.

New mechanism of superconductivity is presented, which utilizes antiferromagnetic spin waves. It is found that the spin wave coherence strongly enhances the coupling constant, which gives rise to a rather high critical temperature.

17065 (INS—648) **μ/sup +/SR studies of magnetic properties of the YBa/sub 2/Cu/sub 3/O/sub x/ system.** Nishida, Nobuhiko; Miyatake, Hideaki; Shimada, Daisuke. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751971/JAW.

We report the first observation of a new magnetically ordered state in the oxygen-poor tetragonal insulating phase of YBa/sub 2/Cu/sub 3/O/sub x/. Four different single-phase samples have been probed by positive muon spin relaxation (μ/sup +/SR). Each phase was found to show different magnetic behaviour. In the famous orthorhombic 90 K superconductor (x ~ 6.9), neither magnetic ordering nor magnetic fluctuations were observed. However, in another orthorhombic superconducting phase (x ~ 6.4, T/sub c/ ~ 60 K) a magnetic fluctuation was observed below 7 K via muon spin - nuclear spin double relaxation. Its magnetic ordering temperature was below 2.4 K. Similar behaviour was observed in an oxygen-rich (x ≧ 7) tetragonal insulating phase, whereas the oxygen-deficient (x ~ 6.2) tetragonal insulating phase was found to be magnetically ordered, most likely antiferromagnetic, near room temperature.

17066 (IPNO-TH—86-32) **Collective excitations of closed shell nuclei in heavy ion grazing collisions.** Chomaz, P.; Giai, N. Van; Vautherin, D. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Apr 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751745/JAW.

The single and multiple excitations of giant resonances in heavy ion reactions is investigated in the framework of a microscopic model. The scattering process is treated semi-classically as in the Copenhagen model but the target response is constructed from a microscopic R.P.A. calculation using Skyrme forces. The importance of an accurate description of excitation operators and transition form factors is stressed. The connection with other approaches (time-dependent Hartree-Fock approximation, boson expansion method, second R.P.A.) is discussed. The model is applied to reactions involving /sup 208/Pb and /sup 40/Ca nuclei. We conclude that, under near-grazing conditions, with medium or heavy projectiles and for incident energies around 30MeV/nucleon, there is a substantial probability of observing multiphonon states built on 2h/2πw giant resonances.

17067 (IPNO-TH—86-65) **Δ-production in proton-nucleus scattering at intermediate energies.** Faeldt, G.; Lazard, C.; Lombard, R. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Dec 1986. 50p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751747/JAW.

The theory is based on the Glauber multiple scattering theory. For the elementary NN -> ΔN process, we employ the amplitude decomposition by Silbar et al. and by Auger et al. The numerical values of the parameters involved are taken from the work of Kloet and Silbar. Two specific examples of nuclear targets are examined: Δ/sup ++/-production on /sup 3/He and /sup 6/Li at 800 MeV. The effects of multiple scattering corrections on selected spin observables are studied in detail. In light of our results we discuss the possibilities of using nuclear reactions to obtain information on specific production amplitudes and on Δ-propagation through the nuclear medium.

17068 (IPNO-TH—87-4) **Relativistic approach to nuclear structure.** Nguyen Van Giai; Bouyssy, A. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Mar 1987. 29p. (CONF-8703177—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751397/JAW.

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Some recent works related with relativistic models of nuclear structure are briefly reviewed. The Dirac-Hartree-Fock and Dirac-Brueckner-Hartree-Fock are recalled and illustrated by some examples. The problem of isoscalar current and magnetic moments of odd nuclei is discussed. The application of the relativistic model to the nuclear response function is examined.

17069 (IPNO-TH—87-10) **Critical exponents in nucleus breakup.** Campi, X. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Jan 1987. 9p. (CONF-870153—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751399/JAW.

From 25. international winter meeting on nuclear physics; Bormio, Italy (19 Jan 1987).

In recent years the study of cluster formation has become a new field in statistical physics. Nuclear reactions with particle number change can be viewed as a cluster formation processes. Multifragmentation decay produces a power law distribution of medium size clusters. These two cluster size distributions resemble that of many others statistical cluster formation processes. We discuss now these analogies in some details.

17070 (IPNO-TH—87-43) **Mean square deviation from a slater determinant and scaling effects in models of the correlated ground state of nuclear matter and of /sup 208/Pb.** Jaminon, M.; Mahaux, C.; Ngo, H. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751404/JAW.

It is proposed to characterize the deviation of the one-body density matrix, of the correlated nuclear ground state from that, of an uncorrelated system. This "mean square deviation per nucleon" has a lower bound, σ /sub min/ which is reached when the uncorrelated many-body wave function is constructed with the natural orbitals. It is shown that in the case of nuclear matter this minimum can be expressed in terms of the momentum probability distribution. In a nucleus the expression of σ/sub min/ involves the occupation probabilities of the natural orbitals. The value of σ/sub min/ is evaluated in the case of various models which have recently been introduced in order to study the effect of correlations on the density and momentum distributions of protons in /sup 208/Pb. We investigate how the latter quantities are modified when previous approximations for the natural orbitals are modified by performing either a scaling transformation or by changing the Woods-Saxon potential from which these natural orbitals are generated. Two sets of single-particle orbitals are found which yield good agreement with the experimental values of both the charge and momentum density distributions of /sup 208/Pb when realistic occupation probabilities are introduced; the latter correspond to a 11.6% depletion of the Fermi sea, of which only 3.6% arise from long range correlations as described by the random phase approximation.

17071 **(ISN—87-30) On isoscalar giant resonances at finite temperature.** Suraud, E.; Barranco, M.; Treiner, J. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Mar 1987. 17p. (CONF-870153—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751630/JAW.

From 25. international winter meeting on nuclear physics; Bormio, Italy (19 Jan 1987).

We study the temperature dependence of giant isoscalar resonances within a semi-classical framework and by means of finite temperature sum rules. We show in particular that spurious effects are generated by the external gas if this latter is not taken properly into account. We find that the monopole resonance energy smoothly decreases with increasing temperature, and that its width is presumably little affected by temperature effects. We also calculate the resonance energies for higher multipolarities (l=2,3,4) and estimate that they do not drastically depend on the temperature.

17072 **(ISN—87-39) Disintegration of nuclei and formation of composite systems in intermediate energy heavy ion reactions.** Gregoire, C.; Jacquet, D.; Remaud, B.; Sebille, F.; Vinet, L.; Pi, M.; Suraud, E.; Schuck, P. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Apr 1987. 18p. (CONF-8704188—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751631/JAW.

From Symposium on central collisions and fragmentation processes; Denver, CO, USA (7 Apr 1987).

In a first part, the Landau-Vlasov dynamical instabilities found in the expansion of an excited nucleus are discussed with their dependence on the initial preparation. In a second part, we show the absence of fusion window when residual interactions are involved. We describe also onset and properties of ineffectual and incomplete fusion for systems like /sup 40/Ar + /sup 27/Al and /sup 238/U near the Fermi energy and /sup 12/C + /sup 139/La at 50 MeV/u.

17073 **(ISN—87-43) On Landau Vlasov simulations of giant resonances.** Pi, M.; Schuck, P.; Suraud, E.; Gregoire, C.; Remaud, B.; Sebille, F. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). May 1987. 6p. (CONF-8705195—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751406/JAW.

From International symposium on collective phenomena in nuclear and subnuclear long range interaction in nuclei; Bad Honnef, F.R. Germany (4 May 1987).

We present VUU calculations of giant resonances obtained in energetic heavy ion collisions. Also is considered the case of the giant dipole in /sup 40/Ca and the possibility of studying the effects of rotation on such collective modes.

17074 **(JINR—R-4-87-178) Scattering of low-energy pions by p-shell nuclei.** Khankhasaev, M.Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. (In Russian). (CONF-8704255—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701164/JAW.

From 5. All-Union conference on experimental research program at meson plant of INR; Zvenigorod, USSR (1 Apr 1987).

Low-energy pion-carbon scattering (up to 50 MeV) is analysed in the framework of the unitary approach based on the method of evolution in the coupling constant. It is shown that at pion energy ~ 50 MeV the differential cross section arises as a result of the strong interference between the pure potential scattering and absorption channels. In this energy region the scattering data are very sensitive to the dynamics of the pion-nucleus interaction. 19 refs.; 1 fig.; 3 tabs.

17075 **(JINR—R-6-86-821) Perspectives for the investigation of radioactive decay of heavy nuclei with nucleon cluster emission.** Zamyatin, Yu.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700924/JAW.

Some experiments are discussed aimed at clarifying a mechanism of heavy-element nucleus spontaneous decay with emission of particles which mass is intermediate between α particle and fission fragments. These experiments could provide a possibility for choosing different models describing this process. The difficulties of realization of such experiments and possible ways of their overcoming are discussed. 17 refs.; 1 fig.; 1 tab.

17076 **(JINR-E—2-86-707) Effects of hadronic colour structure in quasi-elastic and charge-exchange scattering on nuclei.** Kopeliovich, B.Z.; Zakharov, B.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700265/JAW.

Submitted to the journal Yad. Fiz.

Effects of hadronic hidden colour screening are considered in hadron-nucleus interaction. It is shown that in the quasi-free charge exchange-reaction nuclear matter becomes transparent for the scattered hadron if the momentum transfer is large enough. The available experimental data confirm this prediction of QCD. 19 references.

17077 **(LA-UR—87-3703) Relativistic hydrodynamics and heavy ion reactions.** Strottman, D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 10p. (CONF-8702100—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003179/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

The possibility of forming a new state of nuclear matter - the quark-gluon plasma - in relativistic heavy ion collisions is currently the subject of intense theoretical and experimental investigation. The possible formation and evolution of the plasma is investigated using relativistic hydrodynamics. Nuclei are nearly transparent at the high bombarding energies involved and it is necessary to use a two-fluid model to describe the initial stages of the reaction. The current status of the numerical techniques and the relevant physics is reviewed. 15 refs., 3 figs.

17078 **(LA-UR—87-4102) Nuclear transitions induced by atomic excitations.** Dyer, P.L.; Bounds, J.A.; Haight, R.C.; Luk, T.S. (Los Alamos National Lab., NM (USA); Illinois Univ., Urbana (USA). Dept. of Physics). 1988. Contract W-7405-ENG-36. 7p. (CONF-880141—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004311/JAW.

From Innovative science and technology symposium; Los Angeles, CA, USA (13 Jan 1988).

In the two-step pumping scheme for a gamma-ray laser, an essential step is that of exciting the nucleus from a long-lived storage isomer to a nearby short-lived state that then decays to the upper lasing level. An experiment is in progress to induce this transfer by first exciting the atomic electrons with uv photons. The

incident photons couple well to the electrons, which then couple via a virtual photon to the nucleus. As a test case, excitation of the ^{235}U nucleus is being sought, using a high-brightness uv laser. The excited nuclear state, having a 26-minute half-life, decays by internal converison, resulting in emission of an atomic electron. A pulsed infrared laser produces an atomic beam of ^{235}U which is then bombarded by the uv laser beam. Ions are collected, and conversion electrons are detected by a channel elctron multiplier. In preliminary experiments, an upper limit of 7×10^{-5} has been obtained for the probability of exciting a ^{235}U atom in the uv beam for one picosecond at an intensity of about $10^{15} W/cm^2$. Experiments with higher sensitivities and at higher uv beam intensities are underway. 6 refs., 1 fig.

17079 (LA-UR—87-4297) A nuclear structure study of the proposed gamma-ray laser candidate nucleus ^{186}Re. Madland, D.G.; Strottman, D.D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 12p. (CONF-880110—12). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004299/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

We present results of theoretical nuclear structure model calculations for the gamma-ray laser candidate nucleus ^{186}Re proposed by Collins. Our calculations of this odd-odd transitional nucleus are based on an axially-asymmetric (particle plus triaxial rotor) model for constructing the orbitals of the odd nucleons that couple under the influence of the residual neutron-proton interaction. We include pairing correlations in the determination of these orbitals by using the BCS approximation with newly determined pairing strengths. The matrix elements of the residual neutron-proton interaction are obtained using phenomenological spin-dependent δ function potentials of both surface and volume forms. We examine the sensitivity of the calculated low-excitation level structure of ^{186}Re to the strength of these potentials. Calculated energy levels of ^{186}Re will be presented and compared with experiment. The impact of our results on the proposed use of ^{186}Re as a gamma-ray laser will be discussed. In addition, based upon these and other model calculations to be described, we assess the level of effort necessary in a full-scale theoretical search for a viable candidate nucleus for a gamma-ray laser. 17 refs., 1 fig., 3 tabs.

17080 (LAL—87-19) Introduction to QED radiative corrections for experimentalists. Haissinski, J. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Mar 1987. 33p. (CONF-8611142—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751412/JAW.

From Workshop on electroproduction of K mesons and pions; Clermont-Ferrand, France (24 Nov 1986).

To experimentalists, radiative corrections (RC) may just look like a complication coming into their data analysis. But one should keep in mind that RC played a crucial role in the development of QED and in its establishment as a fundamental theory. These corrections enable one to make predictions of extreme precision which, up to now, have never been contradicted by experiment. Radiative corrections have gained a renewed importance in recent years, both in electroweak theory and in quantum chromodynamics (QCD). The scope of the following introduction to radiative corrections will be limited to QED.

17081 (LYCEN—8702) 9. Biennial session of nuclear physics. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Mar 1987. 375p. (In French and English). (CONF-8703177—). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW.

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

As every two years the 9th biennial session of nuclear physics shall try to make a survey of the recent experimental developments as well as the evolution of the theoretical ideas in Nuclear Physics. Communications are indexed and analysed separately.

17082 (LYCEN—8702, pp C.5.1-C.5.13) New results obtained by a mean field description of exotic nuclear properties. Heenen, P.H. (Universite Libre de Bruxelles, Belgium). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

I present a new method for solving the Hartree-Fock equations which does not make a priori assumptions on the deformation of the mean-field. Applications to Cs isotopes, to the octupole deformations of /sup 222/Ra and to the rotation of /sup 24/Mg are discussed. The projection on parity of the ground state of /sup 222/Ra, which requires to go beyond the Hartree-Fock method is also presented.

17083 (LYCEN—8702, pp C.14.1-C.14.23) Temperature measurements in heavy ion collisions between 10 and 100 MeV/u critical analysis and recent results. Tamain, B. (ISMRA, 14-Caen, France). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Intermediate energy heavy ions are the unique probe which can be used to form and study very hot nuclei. The first experimental problem is to sign or to isolate such nuclei, and then to measure their temperature. In this paper, we discuss the various methods which have been recently carried out. None of them is able to give easily an unambiguous result. However, by using several sets of data, it is possible to progress and to be sure that very hot nuclei have really been observed. One can then study their properties. The same experimental methods will be available to test the thermalization concept above the boiling point of nuclear matter.

17084 (LYCEN—8702, pp C.15.1-C.15.19) Strangeness and the skyrme model. Vento, V. (Valencia, Univ., Spain). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

We study models of baryon structure based on effective chiral field theories of mesons. We concentrate on the SU(3) flavor sector. We review the collective coordinate quantization method and discuss the fundamental role played by the Wess-Zumino term. We then proceed to analyse the bound state method and its consequences. We end up by looking into some novel phenomenological implications of our investigation.

17085 (LYCEN—8702, pp C.16.1-C.16.17) Core polarization in stretched spin states. Its role in inelastic proton and electron scattering. A case study of the 9/sup -/E/sub x/ =3.522 MeV state in /sup 116/Sn. Van Der Werf, S.Y. (Kernfysisch Versneller Instituut, Groningen, Netherlands). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

The role of core polarization in stretched spin states is investigated. We focus on stretched states of natural parity and present a case study of the 9/sup -/ state at 3.522 MeV in /sup 116/Sn. With data on five independent observables available this is the best documented example of a natural parity stretched (yrast-) state. The observables are: the electron scattering longitudinal and transverse form factors, the proton-scattering cross section and asymmetry and the proton-stripping cross section on /sup 115/In. By including a fully microscopic description of the core polarization it is possible to account quantitatively for all five observables using an effective free nucleon-nucleon interaction for the proton scattering and the free values for the coupling constants for electron scattering. Quenching factors for the leading shell model components are found to be similar in magnitude as for unnatural parity states.

17086 (LYCEN—8702, pp S.1.1-S.1.4) **Regeneration of K/sup 0//sub s/ on nuclei and neutron densities.** Abgrall, Y.; Belaidi, R.; Labarsouque, J. (Bordeaux-1 Univ., 33 Gradignan, France. Laboratoire de Physique Theorique). Mar 1987. (In French). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

In this paper we study some aspects of the regeneration of K/sup 0//sub s/ on nuclei, in particular the radial localization of the process as well as the sensitivity to neutron densities.

17087 (LYCEN—8702, pp S.2.1-S.2.6) **Mesonic exchange currents and longitudinal response measured in inelastic electron scattering.** Desplanques, B. (Paris-11 Univ., 91-Orsay, France. Institut de Physique Nucleaire). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

The contribution of meaonic exchange currents to the longitudinal response measured in inclusive scattering on nuclei is discussed. In doing so, it is continuously referred to the 3-nucleon system where the status of such a contribution is presently known.

17088 (LYCEN—8702, pp S.9.1-S.9-13) **Microscopic description of low energy excitations of even odd and odd-odd nuclei.** Bennour, L.; Libert, J.; Medjadi, D.; Meyer, M.; Quentin, P. (Paris-11 Univ., 91-Orsay, France C.S.N.S.M.; Ecole Normale Superieure, Alger, Algeria; Lyon-1 Univ., 69-Villeurbanne, France. Institut de Physique Nucleaire; Bordeaux-1 Univ., 33-Gradignan, France. Laboratoire de Physique Theorique). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Quadrupole inertial parameters are evaluated in a self-consistent approach, beyond the Inglis cranking approximation, when pairing correlations are present. The influence of their variation on the solutions of Bohr collective Hamiltonian describing even-even nuclei is then discussed. The resulting collective wavefunctions are coupled to one quasi-particle states to describe odd nuclei. Finally, the validity of the nucleon-nucleon force in use, is assessed from a thorough study of the spectra of some selected odd-odd nuclei.

17089 (LYCEN—8702, pp S.10.1-S.10.2) **Rotational alignment and stable octupole deformation.** Briancon, C.; Mikhailov, I.N. (Paris-11 Univ., 91 - Orsay, France. C.S.N.S.M.; J.I.N.R., Dubna, USSR). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

The properties of transitional and well-deformed nuclei in the actinide region are discussed in relation with the existence of octupole deformation of the mean field. The Coriolis effects leading to the alignment of the vibrational angular momentum are studied on the basis of an Hamiltonian including a rotational part depending on the difference between the total angular momentum and the angular momentum associated with the octupole vibrations of the nuclear surface, including also a second term describing the excitation of vibrational degrees of freedom and with in addition to the harmonic part, a term describing the anharmonic effects.

17090 (RAL—86-091) **Solid antimatter.** Michaelis, M.M.; Bingham, R. (Rutherford Appleton Lab., Chilton (UK)). Nov 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750941/JAW.

The paper concerns the problems of creating solid antimatter. The present experiments associated with the creation are outlined, along with the progress that has been made. A description is also given of the theoretical and experimental tasks that must be accomplished before solid antimatter is produced. However it is anticipated that with the advent of laser acceleration of particles, the production of solid antimatter may not be the enormous enterprise initially envisaged. (U.K.).

17091 (UCRL—97722) **Prompt processes in heavy ion reactions.** Blann, M.; Remington, B.A. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 24p. (CONF-871243—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004399/JAW.

From Symposium on hot nuclei; College Station, TX, USA (7 Dec 1987).

We test a relaxation model based on two body nucleon-nucleon scattering processes to interpret phenomena observed in heavy ion reactions. We use the Boltzmann Master Equation to accomplish this. By assuming that the projectile nucleons partition the total excitation with equal a-priori probability of all configurations, we are able to reproduce several sets of neutron spectra from ^{20}Ne and ^{13}C induced reactions on ^{165}Ho and from reactions of ^{40}Ar or ^{40}Ca. We point out ambiguities in deducing angle-integrated energy spectra from double differential spectra. With no additional free parameters, our model successfully reproduces a large body of high energy γ-ray spectra by assuming an incoherent n-p-bremsstrahlung mechanism. 45 refs., 13 figs.

17092 (UCRL—97778) **Multiple preequilibrium decay processes.** Blann, M. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 14p. (CONF-880232—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004401/JAW.

From Nuclear Energy Agency Nuclear Data Committee (NEANDC) specialists' meeting on preequilibrium nuclear reactions; Semmerling, Austria (10 Feb 1988).

Several treatments of multiple preequilibrium decay are reviewed with emphasis on the exciton and hybrid models. We show the expected behavior of this decay mode as a function of incident nucleon energy. The algorithms used in the hybrid model treatment are reviewed, and comparisons are made between predictions of the hybrid model and a broad range of experimental results. 24 refs., 20 figs.

17093 (UCRL—98028) **Effects of realistic partial state densities on preequilibrium decay.** Blann, M.; Reffo, G. (Lawrence Livermore National Lab., CA (USA); ENEA, Bologna (Italy)). Jan 1988. Contract W-7405-ENG-48. 7p. (CONF-880239—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005368/JAW.

From International Atomic Energy Agency coordinated research project; Vienna, Austria (14 Feb 1988).

We reported earlier on the inclusion in code ALICE of a subroutine which calculates partial state densities for preequilibrium decay using realistic single particle levels. In this work we present results using single particle levels due to Seegar-Howard and Seegar-Perisho. Since the earlier work, we have modified the intranuclear transition rates for nucleon scattering based on the final density of three exciton states available. We summarize the changes made in the hybrid subroutine of ALICE and present our results. 5 refs., 1 fig.

17094 **Four-body calculation of the 0^+-1^+ binding energy difference in the A = 4 Λ hypernuclei.** Gibson, B.F.; Lehman, D.R. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* 37: No. 2, 679-691(Feb 1988). Contract FG03-86ER40271.

The coupled, two-variable integral equations that determine the /sub Λ/^{4}He and /sub Λ/^{4}H ground and first excited states, when the NN and ΛN-ΣN interactions are represented by separable potentials, are solved numerically. We find the spin-isospin suppression of the Λ-Σ conversion due to the composite nature of the ^{3}He, ^{3}H nuclear cores to be a significant factor in understanding the 0^+/sup -/1^+ binding energy difference.

17095 **Systematics of B(E2;$0_i^+ \rightarrow 2_1^+$) values for even-even nuclei.** Raman, S.; Nestor C.W. Jr.; Bhatt, K.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* 37: No. 2, 805-822(Feb 1988). Contract AC05-84OR21400.

We have completed a compilation of experimental results for the electric quadrupole transition probability B(E2)up-arrow between the 0^+ ground state and the first 2^+ state in even-even nuclei. The adopted B(E2)up-arrow values have been employed to test the various systematic, empirical, and theoretical relationships proposed by several authors (Grodzins, Bohr and Mottelson, Wang et al., Ross and Bhaduri, Patnaik et al., Hamamoto, Casten, Moeller and Nix, and Kumar) on a global, local, or regional basis. These systematics offer methods for making reasonable predictions of unmeasured B(E2) values. For nuclei away from closed shells, the SU(3) limit of the intermediate boson approximation implies that the B(E2)up-arrow values are proportional to (e/sub p/N/sub p/+e/sub n/N/sub n/)^2, where e/sub p /(e/sub n/) is the proton (neutron) effective charge and N/sub p/ (N/sub n/) refers to the number of valence protons (neutrons). This proportionality is consistent with the observed behavior of B(E2)up-arrow vs N/sub p/N/sub n/. For deformed nuclei and the actinides, the B(E2)up-arrow values calculated in a schematic single-particle "SU(3)" simulation or large single-j simulation of major shells successfully reproduce not only the empirical variation of the B(E2)up-arrow values but also the observed saturation of these values when plotted against N/sub p/N/sub n/. .AE

17096 **Comment on the characterization of the giant quadrupole resonance in /sup 208/Pb as reported from $\pi i/\pi^-$ scattering.** Horen, D.J.; Beene, J.R.; Bertrand, F.E. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* 37: No. 2, 888-890(Feb 1988). Contract AC05-84OR21400.

Studies of π^+/π^- inelastic excitation of the giant quadrupole resonance in /sup 208/Pb have been interpreted as implying a quadrupole matrix element ratio for neutron to proton excitations of M/sub n//M/sub p/ = 3.8, and a reduced electric transition rate of B(E2)up-arrow = 1010 +- 600 e^2fm^4. These values are in strong disagreement with the results of a large body of inelastic light-ion scattering data as well as recent electron scattering results, all of which are consistent with a predominantly isoscalar character for this resonance. A similar situation prevails for the scattering of 400-MeV /sup 16/O and 1428-MeV /sup 17/O ions where Coulomb excitation is important, and the inelastic cross sections are very sensitive to B(E2)up-arrow as well as the hadronic interaction strength. Studies of the photon decay of the giant quadrupole resonance are also in good agreement with random phase approximation calculations that imply a predominantly isoscalar character; this agreement would be destroyed if the interpretation of the pion experiment were correct.

17097 **Breakup-fusion analysis of continuum spectra of α- and h-induced reactions.** Udagawa, T.; Li, X.h.; Tamura, T. (Department of Physics, University of Texas, Austin, Texas 78712). *Physical Review [Section] C: Nuclear Physics;* 37: No. 2, 429-444(Feb 1988).

Calculations are performed for the continuum spectra of protons, deuterons, and tritons emitted from α- and h-induced reactions of the breakup type. It is shown that the sum of the elastic breakup and breakup-fusion contributions fit the major parts of the observed spectra, except for the (α, p) case, where the theory underestimates experiment. It is then shown that the contributions from the quasi-elastic channel, in which T = 1 dinucleons are created, account for most of the remaining (α,p) cross section. The quasi-elastic breakup and breakup-fusion are further shown to nicely fit two-proton coincidence data. The question of radial regions where the various modes of reactions dominantly occur is clarified, making it possible to understand why the various modes of reactions explain certain portions of the observed spectra.

17098 **Structure of the ^{6}Li$\rightarrow$p+(nα) vertex: ^{6}Li(p,2p)nα reaction.** Christou, C.T.; Lehman, D.R.; Parke, W.C. (Department of Physics, The George Washington University, Washington, D.C. 20052). *Physical Review [Section] C: Nuclear Physics;* 37: No. 2, 458-476(Feb 1988).

Three-body models of the ^{6}Li nucleus are used to derive the coincidence cross sections for the reaction ^{6}Li(p,2p)nα. It is shown that in the plane-wave impulse approximation, the fourfold differential cross section factorizes in such a way that the ^{6}Li$\rightarrow$p+(nα) joint momentum distribution may be extracted from experimental measurements. The calculated results are compared to data from various ^{6}Li(p,2p)nα experiments with incident energies ranging from 100 to 460 MeV. Differences between predictions of various three-body models and of various representations of the underlying two-body interactions are examined. It is concluded that meaningful comparisons are possible only if the beam energy is high enough to ensure proton pole dominance and the detector energy resolution good enough to distinguish crucial spectral features.

17099 **Structure of the ^{6}Li$\rightarrow$p+(nα) vertex: ^{6}Li(e,e/sup '/p)nα reaction.** Christou, C.T.; Lehman, D.R.; Parke, W.C. (Department of Physics, The George Washington University, Washington, D.C. 20052). *Physical Review [Section] C: Nuclear Physics;* 37: No. 2, 477-485(Feb 1988).

Three-body models of ^{6}Li are used to describe the reaction ^{6}Li(e,e'p)nα. Under the impulse approximation, the differential cross section for the ^{6}Li(e,e'p)nα reaction with unpolarized particles factorizes into a product of a kinematical factor, the (off-shell) electron-proton cross section, and a distorted spectral function of the ejected proton in the ^{6}Li nucleus. A prescription by De Forest is used to carry the ep cross section off the proton mass shell. The spectral function, containing all of the nuclear physics in the reaction, is found from the ^{6}Li$\rightarrow$p+(nα) vertex amplitude. A unified theoretical description of both the bound state and the (nα) scattering state is employed to predict the ^{6}Li$\rightarrow$p+(nα) vertex amplitude. For (nα) relative energies below 16 MeV and proton momenta below 200 MeV/c, the P/sub 3/2/ αN resonance dominates the shape of the spectral function. However, the contribution of the outgoing scattering wave due to the S/sub 1/2/ αN interaction has a significant role for momenta of the (nα) pair below 40 MeV/c, making the 2s orbitals in ^{6}Li control the behavior of the momentum distribution near zero momentum transfer to the (nα) pair. Recent coincidence experiments give good agreement with theory. Experimental resolutions are currently not quite capable of discriminating between various S/sub 1/2/ αN interactions used in the three-body calculation.

17100 **Nuclear charge symmetry breaking and the ^{3}H-^{3}He binding energy difference.** Brandenburg, R.A.; Chulick, G.S.; Kim, Y.E.; Klepacki, D.J.; Machleidt, R.; Picklesimer, A.; Thaler, R.M. (Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* 37: No. 2, 781-785(Feb 1988).

We study the ^{3}H- ^{3}He binding energy difference, taking into account the Coulomb interaction and charge symmetry breaking of the nuclear force consistent with recent NN experimental data. Realistic interactions are generated which describe the charge symmetry violations reflected in the different nucleon-nucleon scattering lengths. The influence of nuclear charge symmetry breaking on the perturbative Coulomb contribution to the ^{3}He binding energy is discussed. It is shown that the experimental mass difference can be explained by these and theoretical estimates of other known effects.

17101 **Final-state electronic interactions in allowed beta decay.** Lopez, J.L.; Durand, L. (Physics Department, University of WisconsinMadison, Madison, Wisconsin 53706). *Physical Review [Section] C: Nuclear Physics;* 37: No. 2, 535-543(Feb 1988).

We give a perturbative calculation of the effects of final state electronic interactions on the transition rates in allowed beta decay. The results include a simple relativistic expression for the electron screening correction to the total decay rate for low-Z nuclei which corrects a recent calculation by Drukarev and Strikman, and expressions for the corrections to the decay spectra for transitions to particular final atomic states. We discuss briefly applications to superallowed Fermi transitions and the beta decay of tritium.

17102 **Nuclear structure effects in double-beta decay.** Engel, J.; Vogel, P.; Zirnbauer, M.R. (Physics Department, California Institute of Technology, Pasadena, California 91125). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 2, 731-746(Feb 1988).

Using the quasiparticle random phase approximation, we calculate the nuclear matrix elements governing two-neutrino and neutrinoless double-beta decay. We show that a consistent treatment, including both particle-hole and particle-particle interactions, helps to resolve the longstanding discrepancy between experimental and calculated two-neutrino decay rates. The particle-particle force, which allows us to bring calculated EC/β^+ decay rates in semimagic nuclei into closer agreement with experiment, is in large part responsible for suppressing calculated two-neutrino decay rates that are otherwise too fast. We test the validity of our procedure by comparing quasiparticle random phase approximation results with exact solutions for a solvable model, in which the suppression of two-neutrino decay by the particle-particle interaction is confirmed. We then extend our approach to the neutrinoless decay associated with a finite Majorana neutrino mass and, conceivably, with majoron emission, and demonstrate that the nuclear matrix elements governing these processes are also suppressed. We present predicted half-lives for both two-neutrino and neutrinoless double-beta decay in several candidate nuclei, and discuss the difficulties associated with the calculation of such highly suppressed quantities.

17103 **Shell-model description of the βp decay of the N = 21 and 22 isotones /sup 34/Al, /sup 36/Si, and /sup 37/P.** Warburton, E.K.; Becker, J.A. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 2, 754-765(Feb 1988). Contract AC02-76CH00016.

The nuclear structure of the parent and daughter nuclei in the decays /sup 34/Al(β^-)/sup 34/Si, /sup 36/Si(β^-)/sup 36/P, and /sup 37/P(β^-)/sup 37/S are considered in a spherical shell model comprising the (2s,1d,1f,2p) configuration space. Energy spectra and beta and gamma transition strengths are calculated. These predictions are used to construct decay schemes from recent β^--delayed γ-ray singles spectra for the three decaying nuclei. The predicted half-lives of /sup 34/Al, /sup 36/Si, and /sup 37/P are 0.037(7), 0.8(4), and 2.0(9) s, where the uncertainties are due to mass uncertainties of the decaying bodies. These predictions are in agreement with recent experimental results of 0.050(25), 0.54(15), and 2.31(13) s, respectively.

17104 **Lee et al. reply.** Lee, S.; Fink, J.; Balantekin, A.B.; Strayer, M.R.; Umar, A.S.; Reinhard, P.; Maruhn, J.A.; Greiner, W. (Wright Nuclear Structure Laboratory and Department of Physics, Yale University, New Haven, Connecticut 06511). *Physical Review Letters;* **60**: No. 2, 163-163(11 Jan 1988).

The authors defend their recently published mean-field theory calculations for deformed nuclei. (AIP)

17105 **Comment on "Neutron-star masses as a constraint on the nuclear compression modulus".** Cooperstein, J.; Baron, E.A.; Gerdes, D.; Kahana, S.H. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **60**: No. 1, 68-68(4 Jan 1988). Contract AC02-76ER13001;AC02-76CH00016.

A Comment on the Letter by N. K. Glendenning, Phys. Rev. Lett. 57, 1120 (1986).

17106 **Glendenning replies.** Glendenning, N.K. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **60**: No. 1, 69-69(4 Jan 1988). Contract AC03-76SF00098.

The author defends his assertion that nuclear matter compressibility can be constrained by measured neutron-star masses. (AIP)

17107 **Fluctuations and the thermal mean-field approach.** Rossignoli, R.; Plastino, A.; Vary, J.P. (Physics Department, National University, La Plata 1900, Argentina). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 1, 314-319(Jan 1988).

Fluctuations of selected observables and their dependence on the size of the system are studied within the framework of an exactly solvable model that mimics the interplay between pairing and long range forces. It is found that thermal mean-field results for fluctuations can yield an adequate estimate of the true fluctuations provided one evaluates those fluctuations in a particular manner.

17108 **Tails of the rotational strength function in the nuclear quasicontinuum.** Leander, G.A.; Arve, P.; Lauritzen, B. (UNISOR, Oak Ridge Associated Universities, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 1, 328-335(Jan 1988). Contract AC05-84OR21400;AC05-76OR00033;AS05-76ER04936.

The strength function for collective rotational transitions at high level density manifests itself in quasicontinuum gamma-ray spectra following heavy-ion fusion reactions. The tails of the strength distribution are considered here on the basis of results from a schematic model. In a weak interaction regime, the tails drop off rapidly. In a strong interaction regime, the tails of the standard Breit-Wigner shape are modulated by the level density and by the few-body nature of the residual interaction. This could reduce the B(E2) strength available for rotational decay.

17109 **Coulomb effects in asymptotic normalization constants: A soluble model.** Lehman, D.R.; Maximon, L.C.; Friar, J.L. (Department of Physics, The George Washington University, Washington, D.C. 20052). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 1, 336-348(Jan 1988).

An exactly soluble two-body model is used to investigate Coulomb effects on S-wave asymptotic normalization constants. The model consists of an S-wave separable interaction with and without a repulsive Coulomb interaction. Relative to the case without the Coulomb interaction, it is shown explicitly that an S-wave asymptotic normalization constant is affected in two compensating ways by the presence of the Coulomb interaction: (1) The asymptotic norm decreases due to the decrease in binding energy; (2) the asymptotic norm increases due to the modification in the tail of the wave function brought about by the long-range nature of the Coulomb interaction. For a system like ^{3}He, these are approximately 5% effects that essentially cancel each other, leading to nearly equal asymptotic normalization constants for ^{3}H and ^{3}He.

17110 **Yukawa theories in nuclear physics.** Zahed, I. (Physics Department, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 1, 409-410(Jan 1988).

The validity of Yukawa theories in nuclear physics is questioned beyond the mean-field approximation. It is shown that the large value of the meson-nucleon coupling constant puts an immediate upper bound on the relevant physical scale (about the nucleon mass) and this irrespective of the issue of renormalizability.

17111 **Energy and symmetry of states in light nuclei.** Carlson, J.; Friar, J.L.; Payne, G.L. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 1, 420-422(Jan 1988).

The symmetry properties of low-lying eigenstates of s-shell nuclei are examined, and the lowest energy state is shown to be completely antisymmetric, which corresponds to the physical ground state. Green's function Monte Carlo methods may therefore be applied without the rapid increase in noise usually associated with fermion systems.

17112 **Active target production of muons for muon-catalyzed fusion.** Jandel, M.; Danos, M.; Rafelski, J. (CERN, Geneva, Switzerland). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 1, 403-406(Jan 1988).

Using a Monte Carlo method, we study the energy efficiency of muon production by a high-energy beam of deuterons, i.e., protons and neutrons, injected into infinite deuterium-tritium targets. We present detailed results for the dependence on target density and beam energy. The key role of secondary (shower) production of muons is demonstrated. Constraints on the possibility of muon catalyzed fusion power reactors are established.

17113 **Pion scattering and the nuclear pionic content.** Hong Jung; Miller, G.A. (University of Washington, Seattle, Washington 98195). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 224-232(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

A new method for relating the pion nucleus optical potential to the density of points in the nuclear medium is discussed.

17114 **Pions and the nuclear spin-isospin response.** Johnson, M.B. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 352-372(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

The contribution that pions can make to the task of unraveling the collective spin-isospin response of nuclei is discussed. The adequacy of current theoretical descriptions of pion scattering is assessed for extracting from data the Fermi liquid parameter $g'_0(\Delta\Delta)$, which is required in order to calculate the response function of nuclei but not available from other sources. A theoretical and phenomenological analysis is then used to deduce $g'_0(\Delta\Delta)$ using elastic, inelastic, single-charge-exchange and double-charge-exchange data. New experimental and theoretical initiatives that can capitalize on this and other connections between pion physica and nuclear physics in general are suggested.

17115 **Shell model transition densities for electron and pion scattering.** Millener, D.J. (Physics Department, Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 402-424(1 Dec 1987). (CONF-8708102—). Contract AC02-76CH00016.

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

The general features of an effective interaction suitable for the calculation of cross-shell matrix elements in the /sup 16/O region are discussed. Shell-model transition densities are applied to the 1 h-dash-barω excitation of non-normal parity states in light-nuclei, with /sup 13/C used as a prime example. The longitudinal form factors from such a calculation require enhancement and transverse form factors (spin-excitations) need to be quenched. The shapes of form factors also exhibit systematic discrepancies which are correlated with the discrepancies in magnitude. The problem with shapes is particularly marked for C1 form factors. It is shown that the addition of small components to the transition density, corresponding to the excitation of a single particle through two or three major shells, works in the right direction as far as both magnitude and shape are concerned and that such additions are particularly effective in the case of C1 excitations. For the transverse form factors in /sup 13/C, the use of Woods-Saxon radial wave functions leads to reductions of up to 50% compared with harmonic oscillator wave functions. The excitation of states with dominant multiparticle-multihole components, and the role played by admixtures of such configurations in low-lying states, is considered. Some of the problems associated with the use of shell-model bases extended to include high-lying configurations in the giant resonance region are pointed out.

17116 **Theory of pion double charge exchange.** Auerbach, N. (School of Physics and Astronomy, Tel Aviv University, Tel Aviv 69978, Israel). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 34-53(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

The theory of pion double charge exchange (DCX) to the double isobaric analog resonance is discussed. Emphasis is placed on the role of shell-model correlations in the description of the (π^+, π^-) cross section. The DCX is discussed in the framework of the seniority scheme and also of the generalized seniority scheme. In the last part of this presentation the possibility of observing giant resonances built on excited states in pion DCX reactions is explored.

17117 **Nucleon-nucleon correlations detected via pion double-charge-exchange reactions.** Bleszynski, E.; Bleszynski, M.; Glauber, R.J. (Physics Department, University of California, Los Angeles, CA 90024). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 54-66(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

Double-charge-exchange reactions induced by pions are shown to furnish a direct means of detecting nucleon-nucleon correlations in nuclei. For the particular case of double isobaric analog transitions the effect of correlations is easily isolated and quite strong. Examination of the properties of the position correlations implicit in the nuclear shell model provides an explanation of several experimentally observed features of double-charge-exchange reactions, including in particular, their dependence on the number of valence neutrons present. An explicit demonstration of the role played by nucleon-nucleon correlations is presented for the double-charge-exchange cross sections of the isotopes ^{42}Ca, ^{44}Ca and ^{48}Ca, recently measured at LAMPF. Our analysis explains why the cross section for the double-charge-exchange reaction on ^{48}Ca, in which 28 neutron pairs participate, is comparable and indeed smaller than the corresponding cross-section for ^{42}Ca with its single valence neutron pair. It also predicts the variation of angular distributions over the family of isotopes.

17118 **Monte Carlo simulation of inclusive pionic reaction around resonance and higher energy perspectives.** Oset, E.; Salcedo, L.L.; Strottman, D.; Vicente, M.J.; Garcia-Recio, C.; Hernandez, E. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 100-118(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

We discribe all the inclusive pionic reactions in a variety of nuclei around the resonance region by means of a microscopic many-body calculation that evaluates reaction probabilities, followed by a Monte Carlo simulation which follows the evolution of the pions. We also make an intrusion into the higher energy domain by paying attention to the absorption mechanisms and their repercussions in exclusive single-charge exchange reactions.

17119 **Monte Carlo analysis of pion absorption.** Gibbs, W.R.; Kaufmann, W.B. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 279-288(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

Recent pion absorption data with the observation of two protons in coincidence have been interpreted to yield a small fraction of absorption on two-nucleon pairs compared with absorption on multinucleon clusters. The present work demonstrates that a considerable broadening of the two-nucleon correlation function, and concurrent reduction of observed events, arises from Fermi motion, nucleon binding, pion scattering before absorption and nucleon scattering after absorption. The width of the calculated pp angular correlation distribution agrees well with that observed experimentally. After correction for these effects in the assumed two-body absorption process we find that there is a residual mechanism which must account for ~30% of the true-absorption events.

17120 **Surface response model for quasielastic scattering.** Esbensen, H. (Physics Div., Argonne National Laboratory, Argonne, IL 60439-4843). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 308-320(1 Dec 1987). (CONF-8708102—). Contract W-31-109-ENG-38.

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

A review of the surface response model and its applications to quasielastic nucleon-nucleus scattering at intermediate energies.

17121 **Pion production in the quark compound Bag model of NN scattering.** Lee, T.H. (Physics Div., Argonne Laboratory, Argonne, IL 60439-4843). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 342-351(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

The quark compound Bag model of NN scattering is reviewed and extended to study pion-production from NN collisions.

17122 **Pion double charge exchange and nuclear structure.** Ginocchio, J.N. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 425-437(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

Pion double charge exchange to both the double-analog state and the ground state is studied for medium weight nuclei. The relative cross section of these two transitions and the importance of nuclear structure as a function of pion kinetic energy is examined.

17123 **Delta-hole model in the local density approximation.** Dhuga, K.S.; Ernst, D.J. (New Mexico State University, Las Cruces, New Mexico 88003). *AIP (American Institute of Physics) Conference Proceedings;* **163**: No. 1, 484-501(1 Dec 1987). (CONF-8708102—).

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

The local-density approximation to the delta-hole model is investigated. Features learned from work on the momentum-space approach to the pion-nucleus optical potential are incorporated into the model. Preliminary calculations of pion elastic scattering with the modified model are in excellent agreement with data. The model provides a numerically efficient approach to studying delta dynamics in the nucleus.

17124 **Microscopic theory of multiple scattering for open-shell nuclei.** Johnson, M.B.; Singham, M.K. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Annals of Physics (New York);* **180**: No. 2, 254-289(Dec 1987).

We consider the scattering of a distinguishable projectile from a nucleus assuming that the underlying interaction Hamiltonian is a sum of two-body potentials. We show that the effective interaction of the projectile with the nucleus in a truncated nuclear model space can be calculated as a linked-cluster expansion. The rules for evaluating this expansion are given in terms of the nucleon—nucleon and projectile—nucleon potentials and the exact eigenstates of the (effective) shell-model interaction. The shell-model interaction is required to be an energy-independent, Hermitian potential; its expression in terms of the underlying two-body potential is given by folded diagrams. The terms in the expansion of the effective projectile—nucleus interaction must also contain folded diagrams but, unlike the shell-model potential, these are energy-dependent in order to describe the singularities associated with the crossing of the scattering thresholds as the projectile energy is varied. Once the effective interaction is known, elastic and inelastic scatterings may be evaluated numerically by solving a finite-dimensional coupled-channel equation. copyright 1987 Academic Press, Inc.

17125 **Unitary symmetry and the stability of Σ hypernuclei.** Dover, C.B.; Feshbach, H. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **59**: No. 22, 2539-2542(30 Nov 1987). Contract AC02-76CH00016.

In the limit of unbroken SU(3) symmetry, we exhibit a selection rule which forbids the decay of certain hypernuclear states involving a coherent admixture of Λ and Σ hyperons. This may provide an explanation of the narrow widths of some hypernuclear excitations observed in the Σ continuum.

17126 **On relativistic effects in the low-energy spectra of nuclei.** Muether, H.; Machleidt, R.; Brockmann, R. (State Univ. of New York, Stony Brook, USA. Dept. of Physics; California Univ., Los Angeles, USA. Dept. of Physics; Los Alamos National Lab., NM, USA; Mainz Univ., Germany, F.R. Inst. fuer Physik). *Physics Letters [Section] B;* **198**: No. 1, 45-48(12 Nov 1987). Contract AC02-76ER13001.

The low energy spectra of some 1sOd-shell nuclei are investigated by shell model calculations employing a recent relativistic meson-exchange potential. The interaction is renormalized in a conventional way to account for correlations, which are not contained in the shell-model basis. Special attention is paid to the influence of relativistic medium effects on the calculated spectra. We find that these effects are small and do not spoil the agreement with the experimental data. This finding together with the fact of a quantitative description of ground-state properties of the three-nucleon system and of nuclear matter, using the same NN interaction, can be understood as an indication that modern relativistic meson-exchange potentials may allow for a more consistent explanation of nuclear structure than traditional nuclear force models.

17127 **Supersymmetry in transitional nuclei and its application to the Ru and Rh isotopes.** Frank, A.; Van Isacker, P.; Warner, D.D. (Yale Univ., New Haven, CT, USA. Wright Nuclear Structure Lab.; Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Estudios Nucleares; Sussex Univ., Brighton, UK. School of Mathematical and Physical Sciences; Brookhaven National Lab., Upton, NY, USA). *Physics Letters [Section] B;* **197**: No. 4, 474-478(5 Nov 1987).

We present an application of nuclear supersymmetry in transitional nuclei by establishing a connection between the spectroscopic properties of the even-mass ruthenium and the odd-mass rhodium isotopes.

17128 **Relativistic equation for nucleon-nucleus scattering.** Wallace, S.J. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Annual Review of Nuclear Science;* **37**: No. 1, 267-292(1987).

Relativistic scattering of nucleons from nuclei has been successfully described by the Dirac equation with a mean field nuclear potential. Different formalisms for nuclear structure and the nucleon-nucleus interactions are reviewed. (AIP)

17129 **Pion-nucleus interactions.** Gibbs, W.R.; Gibson, B.F. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Annual Review of Nuclear Science;* **37**: No. 1, 411-461(1987).

This general overview of pion-nucleus interactions is divided into three main categories. They are fundamantal hadronic interactions, nuclear structure, and properties of hadronic systems. (AIP)

17130 **Fermion dynamical symmetry and the nuclear shell model.** Ginocchio, J.N. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 309-321 of Particle and nuclear physics. Ning, H.; Chong-shi, W. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8509276—).

From International symposium on particle and nuclear physics; Beijing, China (2 Sep 1985).

The interacting boson model (IBM) has been very successful in giving a unified and simple description of the spectroscopic properties of a wide range of nuclei, from vibrational through rotational nuclei. The three basic assumptions of the model are that 1) the valence nucleons move about a doubly closed core, 2) the collective low-lying states are composed primarily of coherent pairs of neutrons and pairs of protons coupled to angular momentum zero and two and 3) these coherent pairs are approximated as bosons. In this review the authors shall show how it is possible to have fermion Hamiltonians which have a class of collective eigenstates composed entirely of monopole and quadrupole pairs of fermions.

Furthermore the fermion shell model states excluded in the IBM can be classified by the number of fermion pairs which are not coherent monopole or quadrupole pairs. Hence the mixing of these states into the low-lying spectrum can be calculated in a systematic and tractable manner. Thus they can introduce features which are outside the IBM.

17131 **R matrix analysis of the ^{239}Pu cross sections up to 600 eV.** Derrien, H.; de Saussure, G.; Perez, R.B.; Larson, N.M.; Macklin, R.L. (CEA/CEN, Cadarache, France). *Transactions of the American Nuclear Society;* **52**: 635-636(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The ENDF/B-V representation of the ^{239}Pu neutron cross sections in the resonance region is unsatisfactory: the single-level formalism is used, necessitating a structured file 3 contribution. Furthermore, Salvatores et al. have stressed the need to extend the resolved resonance region above the present ENDF/B limit of 300 eV for the calculation of Doppler effect and self-shielded group cross sections. The purpose of our work is to improve the representation of the ^{239}Pu cross sections by using a multilevel formalism (which avoids the need for the file 3 contributions) and by extending the resolved resonance range from 300 up to 600 eV. The present resonance analysis is based on the Reich-Moore multilevel formalism and was performed with the Bayesian code SAMMY. The resonance parameters published in 1974 by Derrien were used as prior information. More than 200 levels and 1000 resonance parameters are included in the analysis.

17132 **Axial asymmetry in the IBA and an extensive new 0(6) region near A = 130.** Casten, R.F. (Brookhaven National Laboratory, Upton, New York, 11973 and Institut fur Kernphysik, University of Koln, Koln, Germany). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 24-37(15 Jan 1985). (CONF-840906—). Contract AC02-76CH00016.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Although the IBA-1 contains no solutions corresponding to a rigid triaxial shape, it does contain an effective asymmetry arising from zero point motion in a γ-soft potential leading to a non-zero mean or rms γ. In the Consistent Q Formalism (CQF) of the IBA, most results of a calculation depend only on one parameter chi. A relation will be established between chi and the effective asymmetry parameter γ. The relation between the asymmetry occurring naturally in IBA-1 and the triaxiality arising from the introduction of cubic terms into the IBA Hamiltonian will be discussed. It will be shown that γ-band energy staggering is a particularly sensitive indicator of the degree of γ rigidity. Finally, an extensive new region of 0(6) like Xe and Ba nuclei near A = 130 will be discussed. Their remarkable similarity to Pt will be explored. Deviations from the strict 0(6) limit can be described in terms of the interplay of soft and rigid axial asymmetry and calculations will be presented that interpret the Xe, Ba and Pt isotopes in this way.

17133 **Shell effects on the E1 moments of Ra-Th nuclei.** Leander, G.A. (UNISOR, Oak Ridge Associated Universities, Oak Ridge, TN 37830). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 125-131(15 Jan 1985). (CONF-840906—). Contract AC05-76OR00033.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Large systematic shell effects on intrinsic E1 moments are found, which should modulate any E1 moment induced by β_3 deformation. The calculated shell effects can explain an emerging trend for E1 data in Ra-Th nuclei, if and only if the gross β_3-induced polarization of finite nuclear matter goes in the same direction as the "lightning rod" effect.

17134 **Nuclear structure studies with photoreactions.** Iachello, F. (A. W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 153-165(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Recent work on nuclear properties which can be studied with photoreactions is briefly reviewed. It is pointed out that photon inelastic scattering cross sections are very sensitive tests of nuclear structure models. Experiments to test these models are suggested.

17135 **Modeling level structures of odd-odd deformed nuclei.** Hoff, R.W.; Kern, J.; Piepenbring, R.; Boisson, J.P. (Lawrence Livermore National Laboratory, Livermore, California). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 274-289(15 Jan 1985). (CONF-840906—). Contract W-7405-ENG-48.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

A technique for modeling quasiparticle excitation energies and rotational parameters in odd-odd deformed nuclei has been applied to actinide species where new experimental data have been obtained by use of neutron-capture gamma-ray spectroscopy. The input parameters required for the calculation were derived from empirical data on single-particle excitations in neighboring odd-mass nuclei. Calculated configuration-specific values for the Gallagher-Moszkowski splittings were used. Calculated and experimental level structures for /sup 238/Np, /sup 244/Am, and /sup 250/Bk are compared, as well as those for several nuclei in the rare-earch region. The agreement for the actinide species is excellent, with bandhead energies deviating 22 keV and rotational parameters 5%, on the average. Corresponding average deviations for five rare-earth nuclei are 47 keV and 7%. Several applications of this modeling technique are discussed.

17136 **Absolute dipole gamma-ray strength functions for /sup 176/Lu.** Gardner, D.G.; Gardner, M.A.; Hoff, R.W. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 513-516(15 Jan 1985). (CONF-840906—). Contract W-7405-ENG-48.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

We have derived absolute dipole strength-function information for /sup 176/Lu from an average resonance capture study of /sup 175/Lu with 2-keV neutrons, and from neutron capture cross-section measurements with neutrons from 30 keV to about 1 MeV. We found that we needed to increase our previous estimate of the relative m1/E1 strengths near 5 MeV by a factor of 3, and to revise downward the absolute magnitude of our E1 strength function. We accomplished the latter, while still maintaining continuity with the photonuclear data, by adjusting the one free parameter in our line shape. The present E1 and M1 strengths now seem correct both near the neutron separation energy and also around 1 MeV.

17137 **Radiative capture of nucleons in the giant-dipole resonance region.** Dietrich, F.S. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 445-457(15 Jan 1985). (CONF-840906—). Contract W-7405-ENG-48.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Several features of radiative capture in the GDR region are discussed in terms of the direct-semidirect (DSD) and pure-resonance (PRM) models. The relationship of these models is clarified by results of a derivation that explicitly allows for E1 strength decoupled from the GDR. A microscopic folding-model estimate of the coupling form factor is presented, and its consistency with the (p,n) isobaric-analog reaction discussed. A Coulomb-excitation contribution is found to be significant for proton capture. The correlation between the nucleon escape widths and the particle-hole spectroscopy of the GDR is discussed in terms of the single-particle and rearrangement escape amplitudes in the PRM formulation. Applications are made to radiative vapture near A = 208.

17138 **Location of a doorway state using the channel n+/sup 207/Pb.** Dennis, L.C.; Raman, S. (Florida State University, Tallahassee, Florida 32306). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 495-498(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

The location of a doorway state in the n+/sup 207/Pb channel is established through a statistical analysis of the observed partial widths for gamma-rays and neutrons. Several statistical tests developed to help locate doorway states are presented. The statistical analysis focuses on the strong correlation between large partial widths in the two exit channels. Widths in both exit channels exhibit extremely large values in the energy region near E/sub n/ = 120 keV. This clustering of large widths, even when considered separately for each exit channel, is relatively unlikely to occur in a statistical sample. The strong correlation between channels decreases the likelyhood for this clustering of large widths to occur in a statistical sample to less than 0.0003.

17139 **Analysis of n+/sup 197/Au cross sections for E/sub n/ = 0.01—20 MeV.** Young, P.G.; Arthur, E.D. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 530-533(15 Jan 1985). (CONF-840906—).

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

An analysis of n+/sup 197/Au reactions has been completed for incident neutron energies between 0.01 and 20 MeV. The analysis involves use of a deformed optical model to calculate neutron transmission coefficients, a giant-dipole-resonance model and expreimental data to determine gamma-ray transmission coefficients, and Hauser-Fesbach statistical theory to calculate partial reaction cross sections. Particular emphasis was given to obtaining gamma-ray strength functions that are consistent with spectral measurements of gamma-ray emission between E/sub n/ = 0.2 and 20 MeV by Morgan and Newman, while at the same time requiring agreement with (n,γ) and (n,xn) cross-section data.

17140 **Isomer ratio calculations using modeled discrete levels.** Gardner, M.A.; Gardner, D.G.; Hoff, R.W. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 547-550(15 Jan 1985). (CONF-840906—). Contract W-7405-ENG-48.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

We have calculated isomer ratios for the /sup 175/Lu(n,γ), /sup 175/Lu(n,2n), /sup 237/Np(n,2n), /sup 241/Am(n,γ), and /sup 243/Am(n,γ) reactions using modeled level structures in the deformed, odd-odd product nuclei. We find: that the hundreds of discrete levels and their gamma-ray branching ratios provided by the modeling are necessary to achieve agreement with experiment, that many rotational bands must be included in order to obtain a sufficiently representative selection of K quantum numbers, and that the levels of each band must be extended to apropriately high values of aagular momentum.

17141 **Statistical methods of spin assignment in compound nuclear reactions.** Mach, H.; Johns, M.W. (Brookhaven National Laboratory, Upton, New York, 11973, USA McMaster University, Hamilton, Ontario, Canada, L8S 4K1). *AIP (American Institute of Physics) Conference Proceedings;* **125**: No. 1, 889-892(15 Jan 1985). (CONF-840906—). Contract AC02-76CH00016.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Spin assignment to nuclear levels can be obtained from standard in-beam gamma-ray spectroscopy techniques and in the case of compound nuclear reactions can be complemented by statistical methods. These are based on a correlation pattern between level spin and gamma-ray intensities feeding low-lying levels. Three types of intensity and level spin correlations are found suitable for spin assignment: shapes of the excitation functions, ratio of intensity at two beam energies or populated in two different reactions, and feeding distributions. Various empirical attempts are examined and the range of applicability of these methods as well as the limitations associated with them are given.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 14334, 14581, 14628, 15946, 17131, 17189

17142 **(AD-A—185769/7/XAB) Stopping-power effects on Rutherford backscattering analysis in thick targets. Memorandum report.** Niiler, A. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Jul 1987. 26p. (BRL-MR—3615). NTIS, PC A03/MF A01.

Rutherford backscattering (RBS) analysis has become an increasingly important method of characterizing material surface. Its advantages lie in the fact it is nondestructive and can yield absolute results on elemental constituents as well as their depth concentration profiles. The accuracy of stopping powers of ions in matter are one of the major factors that affect the accuracy of RBS. The RBS simulation code PROFILE is used to analyze samples containing Cu, Ni, and Al with several different sets of stopping powers. The results indicate that a given uncertainty in the stopping power may lead to equivalent uncertainties in elemental concentrations and thickness of coatings. The results also indicate that the analysis of thick target RBS data with a complete simulation code such as PROFILE may be very valuable in determining stopping powers of elements.

17143 **(AEEW-R—2133) '1986' WIMS nuclear data library.** Halsall, M.J.; Taubman, C.J. (UKAEA Atomic Energy Establishment, Winfrith). Sep 1986. 38p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750954/JAW.

An updated version, known as the 1986 Library has been developed. It contains data in 69 energy groups for 129 nuclides including fuel, moderator and structural materials, fission products and miscellaneous detectors. This document gives a brief summary of the data, concentrating on 2200 $m.sec^{-1}$ cross sections, Maxwellian averages and resonance integrals, but also including other important data and references where possible. (U.K.).

17144 **(IAE—4234/14) Measurement of thermal neutron beam polarization.** Arzumanov, S.S.; Vojtsik, L.P.; Zhukov, S.V.; Kuznetsov, V.L.; Mostovoj, Yu.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700172/JAW.

Sources of methodical errors when measuring polarization of a thermal neutron beam using the Stern-Gerlach method are considered. It is shown that the method permits to attain the accuracy exceeding 0.5%. Results of polarization measurement using the IR-8 reactor (I.V. Kurchatov Institute of Atomic Energy) beam are presented. 7 references, 2 tables.

17145 **(INFN-LNF—87-83(PT)) Inner shell x-ray photoabsorption as a structural and electronic probe of matter.** Natoli, C.R. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1987. 43p. (CONF-8708129—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701068/JAW.

From NATO-ASI conference on materials modification by high-fluence ion beams; Viana do Castelo, Portugal (24 Aug 1987).

A many-body description of the photoemission and photoabsorption processes is outlined that incorporates the multichannel treatment of the atomic dynamical excitations into the framework of the multiple scattering theory. In this context the interplay between excitation dynamics and electronic and geometrical structure of the ground state is elucidated. A new multiple scattering expansion is derived that takes into account interchannel transitions as well. An application to the analysis of photoabsorption spectra of mixed valence compounds is outlined. The same approach is shown to provide a theoretical model for the study of the evolution from the adiabatic to the sudden regime. Limiting, asymptotic cases are discussed. Finally the unifying approach provided by the multiple scattering theory in the description of photoemission and photoabsorption processes in condensed and gaseous phase matter is illustrated. 30 refs.

17146 (INIS-BR—748, pp 46) **Flux of γ photons in bone and muscle.** Figueiredo, J.M.A. (Minas Gerais Univ., Belo Horizonte, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17147 (INIS-BR—748, pp 55) **Bragg law in self-consistent model.** Keller, W.A.; Campos, H.S. (Bahia Univ., Salvador, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17148 (INIS-BR—748, pp 56) **Attenuation of X-rays in silicon.** Cusatis, C. (Parana Univ., Curitiba, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17149 (INIS-SU—428, pp 40-45) **Measurement of neutron electric charge by means ultracold neutrons.** Borisov, Yu.V.; Borovikova, N.V.; Vasil'ev, A.V. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki; Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Neutron Physics). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780044/JAW. (JINR-N—1[21]-87).

In JINR rapid communications. Collection.

The experiment in collaboration between JINR and Leningrad Nuclear Physics Institute at the nuclear reactor WWR-M is reported. Measurement of the neutron electric charge for the first time by means of ultracold neutrons is described. For this purpose a new experimental device to measure the shift of the neutron beam affected by the electric field has been designed. The differential method of the measurement used in the set-up provides the check of a number of systematic effects. The trial measurement run, carried out during 3 days permitted to obtain for neutron charge q/sub n/=(4.3 +- 7.1)x10/sup -20/ q/sub e/. 11 refs.; 4 figs.

17150 (INIS-SU—431, pp 250) **Calculation of angular and energy distributions of electrons, passed through matter layers by Monte Carlo method. (TRACK program).** Zdesenko, Yu.G.; Tretyak, V.I. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17151 (INIS-SU—431, pp 583) **Development of electromagnetic shower of polarized particles.** Nadzhafov, I.M.; Radzhabov, M.R. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17152 (JAERI-M—87-170) **Energy backscattering of electron beams and absorbed dose in thin layer.** Matsuda, Koji; Kijima, Toshiyuki. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 67p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751995/JAW.

Recent research development in this laboratory concerning radiation effects on the thin layer specimens of organic polymers and p-n junction of semiconductors requires the accurate evaluation of backscattered energy which is especially important for low energy electrons below 1.0 MeV and gives rise to errors of up to some 60 % depending on the materials of backing substrates. The present report describes the past studies on backscattering phenomena on backing substances of various elements and summarizes the experimental results of the measurements of the dose rate absorbed by the thin layer substance on backing substances of various elements as numerical tables which allow convenient determination of dose absorbed by the thin layer specimens on the backing substances.

17153 (LYCEN—8702, pp C.12.1-C.12.9) **Observation of new QED effects in the interaction of ultra-relativistic particles with an aligned crystal.** Remillieux, J. (Lyon 1 Univ. 69-Villeurbanne, France. Institut de Physique Nucleaire). Mar 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88751423/JAW. (CONF-8703177—).

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

The CERN-NA33 experiment was a study of the e/sup +/ - e/sup -/ pair creation rates in an aligned single crystal, of 20 to 160 GeV photons, and also of the radiation of 150 GeV electrons and positrons. At ultra-relativistic energies, electromagnetic conversions arising along a crystal axis can involve super-critical electric fields where QED effects are shown to be dominant.

17154 (NPL-RS(EXT)—81) **Measurements performed at the National Physical Laboratory for an international intercomparison of neutron fluence rate measurements for monoenergetic fast neutrons using the ^{115}In(n,gamma) reaction.** Hunt, J.B. (National Physical Lab., Teddington (UK)). May 1986. 71p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks., LS23 7BQ.

National Physical Laboratory (NPL) participation in an International Bureau of Weights and Measures (BIPM) sponsored neutron fluence rate intercomparison is described. For the neutron energies of 144 and 565 keV, one of the prescribed transfer devices consisted of "matched" pairs of indium foils which were activated via the ^{115}In (n,γ)sup(116m)In reaction. The relative 54 min sup(116m)In activity was determined with a $4\pi\beta$ gas flow proportional counter. The neutron fluence received by the indium foil was determined using the previously calibrated NPL standard long counter. Finally the saturated specific β-activity of sup(116m)In per unit neutron fluence rate, at both neutron energies, is reported. A comprehensive discussion of all the applied corrections is given, and a justification of the results is added as an appendix. Corrections for neutron scattering within the target assembly were difficult to evaluate, particularly at 144 keV, and this effect dominates the uncertainties associated with the transfer device at this energy.

17155 (RAL—86-107) **Introductory theory of neutron scattering.** Gunn, J.M.F. (Rutherford Appleton Lab., Chilton (UK)). Dec 1986. 87p. (CONF-8609361—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750964/JAW.

From Neutron scattering at a pulsed source, summer school; Chilton, UK (16 Sep 1986).

The paper comprises a set of six lecture notes which were delivered to the summer school on 'Neutron Scattering at a pulsed source', Rutherford Laboratory, United Kingdom, 1986. The lectures concern the physical principles of neutron scattering. The topics of the lectures include: diffraction, incoherent inelastic scattering, connection with the Schroedinger equation, magnetic scattering, coherent inelastic scattering, and surfaces and neutron optics.

17156 **Interaction of slow electrons with density fluctuations in condensed materials: Calculation of stopping power.** Knipp, P. (Department of Physics and The James Franck Institute, The University of Chicago, Chicago, Illinois 60637). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 1, 12-17(1 Jan 1988).

The calculation of the energy-resolved scattering of slow (approx. <3 eV) electrons from density fluctuations is extended from crystalline semiconductors to amorphous, condensed materials (solid or liquid). In the Born approximation, the scattering is proportional to S(q,ω), the "dynamical structure factor" of the material. This factor, which exhibits some basic similarities and differences between solids and liquids, is determined by hydrodynamical parameters in the low-q range relevant to slow electrons. For solids, the scattering law remains unchanged when extended from crystalline to amorphous states, so the stopping power remains un-

changed also. The scattering law changes when extended to liquids, but the calculated stopping power remains effectively unchanged.

17157 **X-ray attenuation cross sections for energies 100 eV to 100 keV and elements Z = 1 to Z = 92.** Saloman, E.B.; Hubbell, J.H.; Scofield, J.H. (Center for Radiation Research, National Bureau of Standards, Gaithersburg, Maryland 20899). *Nuclear Data Sheets;* **53**: No. 1, 1-196(Jan 1988).

This work presents for the energy range 0.1—100 keV the National Bureau of Standards (NBS) database of experimental x-ray attenuation coefficients (total absorption cross sections) and cross sections calculated using a relativistic Hartree—Slater model for the photoelectric cross section for all elements of atomic number Z = 1—92. The information is displayed in both tabular and graphical form. Also shown on the graphs are cross sections obtained using the semiempirical set of recommended values of B. L. Henke and co-workers (Atomic Data and Nuclear Data Tables 27, 1 (1982)). A bibliography of the NBS database for this energy range is included. copyright 1988 Academic Press, Inc.

17158 **Theoretical radiation physics and implications for radiobiology.** pp 115 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Atomic and molecular data relevant to radiobiology are surveyed, summarized and organized. A discussion of the known properties of gaseous and liquid water and their suitability as surrogates for tissue is given. A comparison of various radiobiological physics approaches to calculating the temporal and spatial evolutions of the physical and chemical phases is given. Possible implications for biological action are discussed.

17159 **Spur size distribution in water produced by low-let radiations.** Mozumder, A. (Radiation Lab., Univ. of Notre Dame, Notre Dame, IN 46556). pp 93 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Spur size distribution in water is calculated for a — MeV electron by a Monte-Carlo procedure devised earlier by the author. However in the present study accurate dipole oscillator strength distribution is used in conjunction with a realistic formula for the differential cross-section of inelastic collision. When normalized by the total cross-section of inelastic collisions a random number generator gives the value of imminent energy loss. Another random number gives the position of that energy loss according to the Poisson distribution. Energy loss histograms are computed at 5 eV intervals. These are then converted into the distribution of spurs (≦ 100 eV), blobs (100-500 eV) and short tracks (500-5000 eV). Separate distributions are provided for gaseous and condensed phases as well as for the main particle and the entire track.

17160 **Radiation damage to deoxyadenosine in solutions of double stranded poly(dA . T).** Lesiak, K.B.; Wheeler, K.T. (Bowman Gray School of Medicine, Winston-Salem, NC 27103). pp 92 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

When the dimers, dApT and TpdA, were irradiated in solution, the type and distribution of the damage products were different. Because this observation was probably due to stereochemical effects, the type and distribution of damage in double stranded DNA might be quite different from those observed when nucleosides and nucleotides were irradiated. In this study, solutions of ds poly(dA . T) were irradiated with 500 Gy, and the damage products analyzed by HPLC after digestion to nucleosides. In N/sub 2/ saturated solutions only the R isomer of 8,5'-cyclodeoxy-adenosine was detected. Moreover, a compound formed in a quantity similar to that of the cyclo derivative after irradiation of dAdo and dAMP solutions was now observed in a quantity 10 times that of the cyclo derivative. These results suggest that model studies with deoxynucleosides and deoxynucleotides should be cautiously extrapolated to cellular DNA.

17161 **Gamma-ray emission from materials pulsed with 14-MeV neutrons.** Goldberg, E.; Hansen, L.F.; Howerton, R.J.; Komoto, T.T.; Pohl, B.A. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **54**: 301-302(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

A series of experiments has been conducted that involve gamma-ray production from the irradiation of materials with 14-MeV neutrons to further test the Monte Carlo transport code TART and its nuclear data base. Gamma rays emitted from spherical assemblies pulsed at their centers with 14-MeV neutrons were detected at a distant point (8.51-m flight path) with an NE213 detector. The neutron- and gamma-emission spectra were measured simultaneously using pulse-shape discrimination. The 14-MeV neutron source was the T(d,n)^{4}He reaction with the 400-keV deuteron beam from the Lawrence Livermore National Lab. (LLNL) insulated core transformer accelerator. The materials and their thicknesses (in grams per square centimetre) include carbon (17.7), H_2O (13.4 H_2O + 1.1 + Pyrex), aluminum (22.4), iron (31.3), copper (32.9), tantalum (51.5), tungsten (49.0), gold (120.0), thorium (61.6), and ^{238}U (55.7). It is concluded that the integral measurements of gamma-ray leakage spectra provide a sensitive test of the quality of the nuclear cross sections in the 14-MeV neutron energy range and complement the findings of neutron time-of-flight intercomparisons.

17162 **ITS: integrated TIGER series of electron/photon transport codes.** Halbleib, J.A.; Mehlhorn, T.A. (Sandia National Lab., Albuquerque, NM). *Transactions of the American Nuclear Society;* **52**: 378-379(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The ITS system of linear, time-independent coupled electron/photon Monte Carlo transport codes is a group of multimaterial, multidimensional codes designed to provide an accurate description of the production and transport of the electron/photon cascade, with or without the presence of macroscopic electric and magnetic fields. It is based primarily on the ETRAN system, which combines microscopic photon transport with a macroscopic random walk for electron transport. Emphasis is on simplicity of application without sacrificing sophistication of the physical model. Flexibility of construction permits the user to tailor the codes to specific applications and to extend the capabilities of the codes to more complex applications.

17163 **Recent developments in discrete ordinates electron transport.** Morel, J.E.; Lorence, L.J. Jr. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 384-385(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The discrete ordinates method is a deterministic method for numerically solving the Boltzmann equation. It was originally developed for neutron transport calculations, but is routinely used for photon and coupled neutron-photon transport calculations as well. The computational state of the art for coupled electron-photon transport (CEPT) calculations is not as developed as that for neutron transport calculations. The only production codes currently available for CEPT calculations are condensed-history Monte Carlo codes such as the ETRAN and ITS codes. A deterministic capability for production calculations is clearly needed. In response to this need, we have begun the development of a production discrete ordinates code for CEPT calculations. The purpose of this paper is to describe the basic approach we are taking, discuss the current status of the project, and present some new computational results. Although further characterization of the coupled electron-photon discrete ordinates method remains to be done, the results to date indicate that the discrete ordinates method can be just as accurate and from 10 to 100 times faster than the Monte Carlo method for a wide variety of problems. We stress that these results are obtained with standard discrete ordinates codes such as ONETRAN. It is clear that even greater efficiency can be obtained by developing a

new generation of production discrete ordinates codes specifically designed to solve the Boltzmann-Fokker-Planck equation. However, the prospects for such development in the near future appear to be remote.

17164 **Nucleon-meson cascade calculations by Monte Carlo methods.** Alsmiller, R.G. Jr.; Alsmiller, F.S.; Gabriel, T.A.; Hermann, O.W. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 385-387(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In addition to their obvious interest for accelerator shield design, data concerning the nucleon-meson cascades that develop when high-energy nucleons and meson pass through matter are of interest for a diversity of applications. The high-energy transport code HETC, a Monte Carlo code developed at Oak Ridge National Laboratory, has been available for man years and has been used in many applications. A similar code developed by Barashenkov and his co-workers has also been available for many years and has also been used in many applications. At energies ≦ 3 GeV, these two codes are similar in their detailed treatment of particle production from nucleon-nucleus and pion-nucleus collisions by means of the internuclear cascade model of nuclear reactions. For very high energy incident particles (around hundreds of gigaelectron volts), three additional Monte Carlo codes, FLUKA82, CASIM, and MARS, have been developed and used. The major differences between the various codes are the manner in which they account for differential particle production from nucleon-nucleus and meson-nucleus collisions at high energy and the manner in which they approximate the transport of the particles in the cascade at the lower energies (≦ 3 GeV). The various codes have been compared with experimental data and with each other and some of these comparisons will be included in the presentation.

17165 **Two-step acceleration method for transport problems.** Larsen, E.W.; Miller, W.F. Jr. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 416-417(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In recent years, much effort has been focused on understanding and improving the convergence properties of iteration methods for solving transport problems. The comparative advantages and disadvantages of the source iteration (SI), Chebyschev-acceleration, rebalance, diffusion-synthetic acceleration (DSA), and projected acceleration methods are documented in the literature and will not be discussed here except to note that no one single method has proven to be best in all situations. Here we describe a new acceleration method that is more computationally efficient than SI, extremely simple to implement, linear (hence can be theoretically treated by a Fourier analysis), and does not contain any spatial differencing difficulties of the sort that have confronted DSA. However, this method is not as efficient as DSA because its performance degrades as the scattering ratio c approaches 1.0.

17166 **S_n synthetic acceleration scheme for the one-dimensional S/sub n/ equations.** Lorence, L.J. Jr.; Larsen, E.W.; Morel, J.E. (Sandia National Lab., Albuquerque, NM). *Transactions of the American Nuclear Society;* **52**: 417-418(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The authors have developed an S_n synthetic acceleration method for the one-dimensional S/sub n/ equations with linear-discontinuous (LD) spatial differencing, and implemented it in a new version of the ONETRAN code. As in the diffusion-synthetic acceleration (DSA) of Morel, both the zeroth and first moments of the scattering source are accelerated. This is done by using the S_n equations with Gauss quadrature rather than the diffusion equation as the low-order operator in the synthetic acceleration scheme.

17167 **Theory of initial yields of ionization in binary mixtures.** Eggarter, E.; Inokuti, M. (Argonne National Lab., Argonne, IL 60439). pp 36 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

For practically all applications in chemistry and biology, the interactions of charged particles in matter concern mixtures or chemically impure substances. The authors want to study what are the general principles governing the energy partition among the components. The initial yield in the mixture of two non-interacting molecular species should be well understood before we discuss intermolecular energy transfer. The authors write a Fowler equation for any yield. By solving this equation it is possible to see how to relate the W value of the mixture with the W values of the individual gases and their concentrations. They first introduce an approximate analytical treatment and look for connections with experimental data and empirical formulas. For certain selected examples they may solve the Fowler equation numerically. A more general approach includes the analysis of electron degradation in mixtures.

17168 **Analytic representation of the generalized oscillator strength for ionization.** Dillon, M.A.; Wang, Z.W.; Inokuti, M. (Argonne National Lab., Argonne, IL 60439). pp 36 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

The energy distribution of secondary electrons resulting from ionizing collisions of fast charged particles with a molecule is indispensable to microscopic modeling of radiation actions. In the Be the theory, the distribution is determined from a more basic quantity, viz., the generalized oscillator strength for ionization. The authors examine its analytic properties for ionization from a fixed orbital, as a function of the squared momentum transfer K/sup 2/, or of the kinetic energy ω = k/sup 2//2 of an ejected electron. For fixed ω, the generalized oscillator strength is analytic on the complex K/sup 2/ plane except at those points where Δ = [(K-k)/sup 2/ + 2I] [(K + k)/sup 2/ + 2I] vanishes, I being the relevant ionization threshold energy. On the basis of this observation and others, the authors show that the K/sup 2/-dependence of the generalized oscillator strength at fixed ω should be approximated by a polynomial in K/sup 2/ divided by a suitable power of Δ. Through several examples they illustrate the use of the expression in fitting data. The expression provides a compact parameterization of data, which allows dependable interpolation and extrapolation and this is useful for many applications such as stopping-power evaluation and electron-degradation analysis in radiation physics.

6550 Medical Physics

REFER ALSO TO CITATION(S) 14208, 14636, 15826, 16033, 16170, 16233

17169 **(INIS-GB—51) Radiation emissions from visual display units.** Cox, E.A. (Loughborough Univ. of Technology (UK)). 11 Dec 1980. 12p. British Library, Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ. No. 86/03419.

In this survey measurements were made of the radiation in various regions of the electromagnetic spectrum (x-radiation, ultraviolet, visible and infrared, microwave and radio frequencies) from all known types of VDUs currently manufactured or marketed in the United Kingdom.

17170 **(NRPB-GS—6) Exposure to radon daughters in dwellings.** O'Riordan, M.C.; James, A.C.; Green, B.M.R.; Wrixon, A.D. (National Radiological Protection Board, Chilton (UK)). Jan 1987. 31p. H.M. Stationery Office, London, price Pound 5.00.

Radon is a natural radioactive gas which is created in the ground and seeps into houses. It decays to radioactive daughters, which if breathed in, irradiate the lungs, and may increase the risk of lung cancer. The Board recently recommended that exposure to radon daughters in the home should be limited. The essence of the recommendations is that there should be an Action Level of 20 mSv per annum for existing dwellings and an Upper Bound of 5 mSv per annum for future dwellings, the values referring to the effective dose equivalent. The recommendations, which are qualified

in a number of important ways, were published as formal advice on standards of radiation protection. Additional guidance on the background information and evaluation underlying these standards is given in this document.

17171 **(NRPB-R—200) National survey of doses to patients undergoing a selection of routine x-ray examinations in English hospitals.** Shrimpton, P.C.; Wall, B.F.; Jones, D.G.; Fisher, E.S.; Hillier, M.C.; Kendall, G.M.; Harrison, R.M. (National Radiological Protection Board, Chilton (UK)). Sep 1986. 169p. H.M. Stationery Office, London, price Pound 9.00.

Wide variations have been observed for many of the measured and calculated doses during each examination, with range factors between the extreme values frequently in excess of 100 (average per capita annual dose of about 300 μSv). The majority of measurements in each case are, however, generally covered by a much smaller factor of less than five. Significant differences are also apparent between mean doses determined at the individual hospitals participating in the survey, with factors of over 10 not uncommon between corresponding mean values. The present measurements have included no assessment of image quality during examinations.

17172 **(NRPB-R—201) Update on the frequency of medical and dental X-ray examinations in Great Britain - 1983.** Wall, B.F.; Hillier, M.C.; Kendall, G.M. (National Radiological Protection Board, Chilton (UK)). Sep 1986. 29p. H.M. Stationery Office, London, price Pound 4.00.

A survey on the frequency of x-ray examinations in Great Britain in 1977 has been updated, using information collected nationally by the Departments of Health in England and Scotland and data from a sample of x-ray departments. It is estimated that about 35 million medical and dental x-ray examinations were conducted in Great Britain in 1983, corresponding to 644 examinations per thousand head of population. This represents an average increase of 2.3% per year in per capita examination frequency over this 6-year period. Those types of x-ray examination showing substantial increases or decreases are identified, and demographic changes in the general population over this period are used to predict the current distributions of age and sex for patients undergoing a variety of x-ray procedures.

17173 **Neutron spectrum from the little boy mock-up.** Robba, A.A. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 351-353(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Most of the human exposure data used for setting radiation protection guidelines have been obtained by following the survivors of the nuclear explosions at Hiroshima and Nagasaki. Proper evaluation of these data requires estimates of the radiation exposure received by those survivors. Until now neutron dose estimates have relied primarily on calculations as no measurements of the leakage neutron flux or neutron spectrum were available. We have measured the high-energy leakage neutron spectrum from a mock-up of the Little Boy device operating at delayed critical. The measurements are compared with Monte Carlo calculations of the leakage neutron spectrum.

17174 **Stochastics in time - In microdosimetry and in ionization chamber measurements.** Roesch, W.C. (Pacific Northwest Lab., Richland, WA 99352). pp 36 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—). Contract AC06-76RL01830.

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

In microdosimetry we ordinarily deal with the stochastics in the energy deposited in a small mass in a given time. It is also possible to deal with the stochastics in the time required for a given energy deposition. The latter is more complicated because we cannot require that the total energy deposited have a specific, exact value. We can only require that the total energy deposited up to the next to last event be less than a specific value and the total after the last event be greater than or equal to that specific value. The theoretical relations for this time-stochastic case are described. The same theory is applicable to determining the uncertainty in ionization chamber measurements made by observing the time required for the scale reading to reach a specified fiducial mark. Application to this problem is also described.

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REFER ALSO TO CITATION(S) 14925, 14937, 14938, 14939, 14940, 14941, 14942, 14943, 14944, 14945, 14946, 14947, 14948, 14949, 14950, 14951, 14952, 14953, 14954, 14955, 14956, 14957, 14958, 14959, 14960, 14961, 14962, 14963, 14964, 14965, 14966, 14967, 14968, 14969, 14970, 14973, 14974, 14984, 15089, 15090, 15091, 15092, 15093, 15094, 15095, 15098, 15099, 15105, 15178, 15179, 15185, 15186, 15187, 15188, 15189, 15190, 15191, 15192, 15193, 15194, 15195, 15196, 15197, 15198, 15199, 15200, 15201, 15202, 15203, 15204, 15206, 15207, 15209, 15210, 15211, 15212, 15213, 15214, 15215, 15216, 15217, 15218, 15219, 15220, 15221, 15222, 15223, 15224, 15225, 15226, 15227, 15228, 15229, 15230, 15231, 15232, 15233, 15234, 15235, 15236, 15238, 15239, 15241, 15242, 15243, 15244, 15245, 15246, 15247, 15249, 15250, 15251, 15252, 15254, 15256, 15260, 15271, 15281, 15322, 15323, 15344, 15344, 15347, 15347, 15348, 15422, 15452, 15549, 15820, 15909, 16146, 16184, 16185, 16419, 16532, 16535, 16536, 17386

17175 **(BNL—40355) A positronium beam and positronium reflection from LiF.** Weber, M.; Berko, S.; Brown, B.L.; Canter, K.F.; Lynn, K.G.; Mills, A.P. Jr.; Roellig, L.O.; Tang, S.; Viecas, A. (City Coll., New York (USA); Brandeis Univ., Waltham, MA (USA); Bell Labs., Murray Hill, NJ (USA); Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-870731—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003496/JAW.

From 4. international workshop on positrons in gases; London, UK (16 Jul 1987).

A positronium (Ps) beam has been constructed by transmitting monoenergetic, low energy positrons through a gas cell containing either Ar or He which provide an electron to form positronium. The positrons were obtained by magnetically deflecting positrons in the straight section of the positron beamline into a beamline which contained the gas cell and a Ps detection chamber. The two beamlines provide the capability of switching from an experiment which uses positrons (a study of the angular correlation of annihilating radiation - ACAR) to one which uses Ps atoms without breaking vacuum, nor moving equipment. The authors report the characteristics of the two beams and state that very preliminary information has been obtained on the characteristics of the Ps beamline and on the reflection of Ps from a LiF crystal.

17176 **(BNL—40439) Observations of elastic scattering and neutralization of positrons at grazing incidence.** Mayer, R.; Zhang, C.S.; Lynn, K.G.; Throwe, J.; Gidley, D.W.; Frieze, W.E.; Marcus, P.M.; Jona, F. (Brookhaven National Lab., Upton, NY (USA); Michigan Univ., Ann Arbor (USA). Dept. of Physics; International Business Machines Corp., Yorktown Heights, NY (USA). Thomas J. Watson Research Center; State Univ. of New York, Stony Brook (USA). Coll. of Engineering and Applied Sciences). 1987. Contract AC02-76CH00016. 7p. (CONF-870715—7). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003498/JAW.

From 15. international conference on the physics of electronic and atomic collisions; Brighton, UK (22 Jul 1987).

Elastic intensity vs. energy (I-V) spectra have been observed using both positrons and electrons at glancing incidence (83° to 56° with respect to the surface normal) in the energy range of 50 to 480 eV from a variety of crystalline solids. All glancing angle positron I-V spectra have broad (≧100 eV) features relative to electrons under comparable conditions. The enhanced broadening is associated with the reduced penetration depth of the elastically scattered positrons, and peak positions and widths fit a quasi-kinematic calculation for the intensity from Cu(100). In addition, a positronium (Ps) beam has been formed by scattering positrons at grazing incidence. The Ps formed in this manner has a non isotropic distribution which suggests that the Ps has energy ≧50 eV. Experimental Ps angular distribution agrees with a theoretical calculation of Ishii. 19 refs., 2 figs.

17177 (CBPF-NF—018/87) Simple renormalization group method for calculating thermal equations of states. Caride, A.O.; Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700143/JAW.

Renormalization-group (RG) techniques are currently used to derive relevent quantities in the vicinity of the critical point. A real-space RG procedure which directly yields the order parameter for all values of the external parameters (e.g., temperature) is presented. It is as simple as a mean-field calculation, although it provides non trivial results, which can be systematically improved. The method is succesfully illustrated on the square-lattice Potts ferromagnet. The whole approach suggests that the order parameter on a hierarchical lattice is, on every site, proportional to its coordination number.

17178 (CEA-CONF—9052) Laser surface quench processing of zirconium alloys. Richard, A.; Charissoux, C.; Calvet, J.N.; Contre, M.; Mardon, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). May 1987. 10p. (In French). (CONF-8705130—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751543/JAW.

From International conference on laser advanced materials processing: science and applications; Osaka, Japan (21 May 1987).

Zircaloys (Zr-Sn alloys) undergo, in high temperature aqueous medium, a non-uniform corrosion of nodular form. Numerous works show that a best behavior can be got with quench structures. They show meanwhile less good characteristics than structures of α work-hardening type; superficial thermal process is a good compromise. Laser beams allow localized depositions of large quantities of energy in particularly short times. In this study, thermal process conditions are given, together with a parametric study (beam-matter interaction), an application to the surface process of thin products, and a complete characterization of the quenched structures.

17179 (CEA-CONF—9103) E-beam lithography for half micron processing. Lerme, M.; Guegan, G.; Dal'zotto, B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). Mar 1987. 10p. (CONF-8703224—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751558/JAW.

From Workshop on fast prototyping; Grenoble, France (17 Mar 1987).

E-beam lithography is well known to be slow for VLSI production. With e-beam lithography no masks are needed and high overlay accuracy can be obtained. In order to improve the writing time we have to use thin layers of high sensitivity e-beam resists and consequently a trilayer resist system. Such a system has to be optimized for both high resolution and overlay accuracy. The process we use was developed for half micron processing.

17180 (CEA-CONF—9104) Stresses induced by heteroepitaxy. Million, A.; Magnea, N. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Jun 1987. 7p. (In French). (CONF-8706253—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751715/JAW.

From Meeting on physics and characterization; Grenoble, France (3 Jun 1987).

Development of techniques of thin layers of compounds II-VI allows currently the use of substrates having mesh parameter well different from those of the epitaxy layer. A systematic study of stresses in CdTe layers, with molecular beam epitaxy on substrate Cd/sub 0.96/Zn/sub 0.04/Te, has been made in relation to depth/sub x/ by X-ray diffraction on planes parallel to surface and by study of the absorption line.

17181 (CEA-CONF—9117) Specific and latent heat of 2-D electron solid. Glattli, D.C.; Andrei, E.Y.; Williams, F.I.B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). Jul 1987. 10p. (CONF-870774—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751562/JAW.

From 7. electronic properties of two-dimensional systems; Santa Fe, NM, USA (27 Jul 1987).

Absolute specific heat measurements have been made on a 2-D crystal of electrons condensed in the liquid Helium surface. At melting no latent heat is detectable, suggesting a continuous transition.

17182 (CONF-870825—4) Precise determination of Moessbauer lineshape parameters including interference. Mullen, J.G.; Djedid, A.; Bullard, B.; Schupp, G.; Cowan, D.; Cao, Y.; Crow, M.L.; Yelon, W. (Purdue Univ., Lafayette, IN (USA). Dept. of Physics; Missouri Univ., Columbia (USA)). 1987. Contract FG02-85ER45200;FG02-85ER45199. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004821/JAW.

From International conference on the applications of the Moessbauer effect; Melbourne, Australia (17 Aug 1987).

Using 100 Ci ^{183}Ta and 5 Ci ^{183}Ta sources, with LiF and NaCl crystal monochromating filters, we have measured the lineshape parameters for the 46.5 keV and 99.1 keV Moessbauer effect (ME) transitions of ^{183}W and the 100.1 keV transition of ^{183}W. Using an analytic representation of the convolution integral and utilizing asymptotic analyses of the lineshape, we find, for both transmission and microfoil internal conversion (MICE) experiments, accurate values of all ME parameters including width, position, cross section, and interference. This new approach allows deconvolution of source and absorber spectra and gives a simple analytic expression for both as well as their Fourier transforms. The line widths for the 46.5, 99.1, and 100.1 keV transitions are 3.10(10), 0.369(18), and 0.195(12) cm/s, respectively. The interference parameters are -0.00257(9), -0.0093(12), and -0.0107(12) in the same respective order. The agreement between transmission and MICE measurements for the above lineshape parameters is within the experimental errors. We believe these measurements are the first having sufficient precision to allow a quantitative comparison with dispersion theory and they indicate interference parameters 10 to 20% smaller than predicted. Our measured line widths are less than earlier reported values. This is because our analysis of the true lineshape and the study of line asymptotics permits a quantitative determination of the isomer lifetimes rather than the usual lower bound found in earlier ME experiments. 37 refs., 4 figs., 2 tabs.

17183 (CONF-871147—6) Absolute rate measurements of two-photon process of gases, liquids, and solids. Chen, C.H.; McCann, M.P.; Payne, M.G. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003800/JAW.

From 3. international laser science conference; Atlantic City, NJ, USA (1 Nov 1987).

Due to rapid improvements in high-power laser performance, two-photon absorption processes have become a very useful tool for studying the molecular structures of various gases, liquids and solids. However, measurements of absolute two-photon absorption cross sections were more or less ignored previously because of their small size. In this work, we obtained not only the two-photon absorption spectra, but also measurements of their absolute cross sections for various gases, liquids, and solids. 8 refs., 1 fig., 1 tab.

17184 (CONF-8708100—3) Determination of the range of slow electrons in solid polymethylmethacrylate by means of fluorescence measurements. Sasson, R.; Arakawa, E.T.; Braitbart, O.; Weinreb, A. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics; Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004070/JAW.

From International conference on luminescence; Beijing, China (17 Aug 1987).

The distance travelled by a photoelectron of low energy in an anthracene-doped polymer is very weakly dependent on its initial kinetic energy. 2 refs., 1 fig.

17185 (CONF-8711123—1) **Advances in calculating macroionic solution structure.** Hayter, J.B. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003799/JAW.

From 19. Yamada conference on ordering and organization in ionic solutions; Kyoto, Japan (9 Nov 1987).

The techniques of light scattering and small-angle x-ray and neutron scattering have provided prodigious quantities of structural data on a wide variety of colloidal systems in the past decade. Much of this data cannot be analyzed in the absence of a quantitative treatment of the correlations generated in such systems by interparticle interactions. This has led to a pressing need for statistical mechanical descriptions of macroionic solutions which require computational times short compared with typical experimental measurement times. This paper discusses in detail one of the most widely used techniques, the rescaled mean spherical approximation, in the context of the one-component macrofluid model. 20 refs., 2 figs.

17186 (DOE/ER/10742—6) **Development of an x-ray beam line at the NSLS for studies in materials science using x-ray absorption spectroscopy: Annual progress report.** Sayers, D.E. (North Carolina State Univ., Raleigh (USA). Dept. of Physics). 1987. Contract AS05-80ER10742. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004928/JAW.

The research programs reported span virtually the entire range of condensed matter studies involving the fields of solid state physics, chemistry, electrochemistry, materials science and biochemistry. Results are discussed for various groups. Topics reported include work on amorphous chalcogenide semiconductors, particularly photostructural changes, kinetics of structural changes and rapid quenching, bond strengths, force constants and phonons. Also reported are temperature dependent EXAFS studies of bonding in high temperature alloys, amorphous systems, disordered alloys and studies of resolve electronic structure, EXAFS and XANES studies of permanent magnet systems based on $Nd_2Fe_{14}B$, glancing angle EXAFS study of Nb/Al and Nb/Si interfacial systems, x-ray absorption of krypton-implanted solids and high dose implants into silicon, and x-ray absorption and EXAFS studies of superconducting oxide compounds of Cu and related magnetic systems. Work is also reported on XAFS measurements on the icosahedral phase. (LEW)

17187 (HMI—437, pp 73-91) **Extreme cases of the local magnetism.** Biedermann, K.H.; Bueermann, L.; Gross, K.D.; Luszik-Bhadra, M.; Riegel, D. (Freie Univ. Berlin, Germany, F.R. Fachbereich Physik). 1987. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751499/JAW.

In Heavy ion physics at the VICKSI accelerator. A selection of research reports of external research groups.

The combination of heavy ion reactions, recoil implantation, and perturbed γ-angular distribution allows to study the magnetic behaviour of transition metal ions under extreme changes of the metallic environment. All light 4f ions show in the implantation into extremely different host matrices magnetic 4f instabilities and/or valence changes. The implantation of 3d and 4d ions into alkali metals effects strong tendencies to the localization of the d electrons which is for instance documented by the discovery of strongly magnetic 4d systems. The extreme cases of the magnetism for f and d ions were observed in not-alloying systems.

17188 (HMI—437, pp 93-105) **Most deep implantation in semiconductor materials and structures.** Laschinski, J.; Fahrner, W.R.; Braeunig, D. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H., Germany, F.R. Bereich Datenverarbeitung und Elektronik). 1987. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751499/JAW.

In Heavy ion physics at the VICKSI accelerator. A selection of research reports of external research groups.

The high-energy ion implantation as it is made possible by VICKSI opens together with the semiconductor techniques interesting methods to extend fundamental knowledge and to test model assumptions. Also the applicability for the purpose of the improvement of current construction elements could be demonstrated. By this important conditions were made which are necessary for the application as tool for the change of material properties in the volume.

17189 (ILL-RA—1986) **[Overview of Neutron Techniques]. Annual report 86.** (Institut Laue-Langevin, 38 - Grenoble (France)). 1987. 176p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751390/JAW.

This report comes from the Institut Max von Laue-Langevin (ILL) at Grenoble. The purpose of the ILL differs from other research institutes as it is a service institute created so that chemistry, solid state physics, fundamental and nuclear physics, biology and metallurgy specialists can use the unique power of neutron techniques.

17190 (INIS-BR—748, pp 128) **Pertubative expansion for intermediate valence systems.** Martinez, G.; Foglio, M.E. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17191 (INIS-BR—748, pp 73) **Two-dimensional Ising model in triangular lattice.** Mello, E.V.L. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17192 (INIS-BR—748, pp 74) **Two-dimensional Ising model with transverse field (MICT) and anysotropic dillution in bindings: treatment by group of medium field renormalization.** Valadares, E.C. 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17193 (INIS-BR—748, pp 76) **Blume-Emery-Griffiths model as a mapping problem.** Barros, C.P. de. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17194 (INIS-BR—748, pp 81) **Ising model with Bethe-Peirels random phase approximation.** Bernardes, A.T.; Oliveira, M.J. de. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17195 (INIS-BR—748, pp 82) **λ PHI ^{4} numerical simulation for finite temperatures.** Amaral, M.G. do; Carvalho, C.A.A. de; Pol, M.E.; Shellard, R.C. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17196 (INIS-BR—748, pp 84) **Potts model and fluxes.** Magalhaes, A.C.N. de; Essam, J.W. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Bedford Cell., London, England). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17197 (INIS-BR—748, pp 86) **Renormalization group applied to Hubbard model.** Chaves, C.M.G.F. (Pontificia Univ. Catolica do Rio de Janeiro, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17198 (INIS-BR—748, pp 86) **Equation of state in renormalization group theory.** Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17199 (INIS-BR—748, pp 87) **Convolution method.** Oliveira, P.M.C. de. (Universidade Federal Fluminense, Niteroi, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17200 (INIS-BR—748, pp 87) **Renormalization group of the effective field: application to classic spin systems.** Sa Barreto, F.C. de. (Minas Gerais Univ., Belo Horizonte, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17201 (INIS-BR—748, pp 175) **Application of the Hondo-5 method to molecular agglomeration.** Pino Junior, A.D.; Germano, J.S.E.; Rosato, A. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17202 (INIS-BR—748, pp 177) **Band of molecular states of impurities in one and two dimensions.** Andrada e Silva, E.A. de; Cunha Lima, I.C. da; Silva, A.F. da. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17203 (INIS-BR—748, pp 21) **Conductivity in disordered systems.** Latge, A.; Anda, E.V. (Universidade Federal Fluminense, Niteroi, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17204 (INIS-BR—748, pp 73) **Group of renormalization for Ising model in triangular lattice.** Lacerda, A.H.; Moreira, F.G.B. (Pernambuco Univ., Recife, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17205 (INIS-BR—748, pp 176) **Numerical methods of analytical extension in the study of semiconductor amorphous alloys.** Makler, S.S.; Anda, E.V. (Universidade Federal Fluminense, Niteroi, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17206 (INIS-BR—748, pp 51) **Secondary extinction calculated by Taylor series expansion.** Parente, C.B.R.; Mazzocchi, V.L. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17207 (INIS-BR—748, pp 55) **Self-consistent structure factor.** Keller, W.A.; Vasconcelos, D.S. de. (Bahia Univ., Salvador, Brazil). 1986. NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17208 (INIS-BR—748, pp 63) **Study of anharmonic models for imperfect crystals.** Rabelo, J.N.T. 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17209 (INIS-BR—748, pp 64) **Analytical study and Monte Carlo calculation of superficial roughness.** Silva, M.A.A. da; Mokross, B.J.; Caliri, A. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17210 (INIS-BR—748, pp 73) **Finite-size scaling for Ising model with random interactions.** Alcaraz, F.C.; Felicio, J.R.D. de. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17211 (INIS-BR—748, pp 75) **Phase transitions in the Ising model with one corner: group of renormalization.** Saxena, V.K. (Santa Catarina Univ., Florianopolis, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17212 (INIS-BR—748, pp 75) **Criticality of the semi-infinite Ising model.** Plascak, J.A. (Minas Gerais Univ., Belo Horizonte, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17213 (INIS-BR—748, pp 75) **Finite size effects in the thermodynamic properties of the ferromagnetic Ising model by constant interaction.** Caliri, A.; Rosa Junior, S.G. (Sao Paulo Univ., Sao Carlos, SP, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17214 (INIS-BR—748, pp 76) **Compressible Heisenberg model.** Cadorin, J.L.; Figueiredo, W. (Santa Catarina Univ., Florianopolis, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17215 (INIS-BR—748, pp 78) **Conectivity and failure.** Cavalcanti, S.B. (Alagoas Univ., Maceio, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

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17283 (INIS-BR—910, pp 34) **Influence of Fe/sup 4+/ impurity on spin-lattice relaxation of /sup 57/Fe in YFeO/sub 3/.** Nadolski, S.; Lutgemeier, H.; Bohn, H.G. (Polska Akademia Nauk, Warsaw; Kernforschungsanlage Juelich G.m.b.H., Germany, F.R. Inst. fuer Festkoerperforschung). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

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From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

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17310 (INIS-BR—910, pp 67) **Single crystal ESR studies of a nitroxide radical.** Alonso, A.; Nascimento, O.R.; Massaro, V.; Tabak, M. (Johnson e Johnson do Brasil, Sao Paulo; Sao Paulo Univ., Sao Carlos, SP, Brazil. Inst. de Fisica e Quimica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

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17318 (INIS-BR—910, pp 43) **Photoproduction of atomic hydrogen centers in x-irradiated aluminoborate glasses.** Pontuschka, W.M.; Isotani, S.; Piccini, A. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

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17319 (INIS-BR—910, pp 43) **Analysis of the Kinetics of paramagnetic centers in X-ray and U.V. irradiated aluminoborate glasses in the bimolecular reaction model.** Isotani, S.; Furtado, W.; Pontuschka, W.M. (Goias Univ., Goiania, Brazil; Sao Paulo Univ., Brazil. Inst. de Fisica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

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17320 (INIS-BR—910, pp 49) **EPR study of the phase transitions in NaN/sub 3/(SeO/sub 3/)/sub 2/.** Silva, J.C.M. da; Chaves, A.S.; Ribeiro, G.M.; Gazzinelli, R. (Minas Gerais Univ., Belo Horizonte, Brazil. Dept. de Fisica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

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17321 (INIS-BR—910, pp 55) **ESR of β/sup -/ and γ irradiated natural calcites in single crystals and powder form.** (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Grenoble-1 Univ., 38, France). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

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17322 (INIS-BR—910, pp 87) **ESR of osmium (I) and iridium (II) pentacyano, mono-and di-chlorinated species.** Martins, J.S.; Vugman, N.V. (Rio de Janeiro Univ., Brazil. Inst. de Fisica). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

17323 (INIS-mf—11003) **Static and dynamic behaviour of a quasi 1-d Heisenberg antiferromagnet in the long-range ordered state. A nuclear magnetic resonance study performed with a ^{3}He-^{4}He dilution refrigerator.** Voorhoeve, J.C. (Rijksuniversiteit Leiden (Netherlands)). 17 Dec 1986. 146p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700210/JAW.

The goal of this thesis is to clarify the dynamic properties of a one-dimensional S=1/2 isotropic Heisenberg antiferromagnet (HAFM). The physical realization chosen for this model system is $CuSO_4.5H_2O$. The experimental information about the dynamical properties of the electron spin system is obtained from longitudinal proton spin relaxation measurements. In ch.2 the experimental set up is described including the ^{3}He-^{4}He dilution refrigerator for obtaining the required low temperatures, and the rotatable superconducting split-coil magnet. In ch.3 the problems are treated which occur when nuclear relaxation experiments are performed in the long-range order state of $CuSO_4.5H_2O$ and an experimental method is described to measure the proton spin-lattice relaxation time T_1 supplying a minimum of energy to the nuclear spin system. In ch.4 continuous-wave NMR experiments on $CuSO_4.5H_2O$ are described. In ch. 5 experimental results on the relaxation rate T_1^{-1} above and in the vicinity of the phase transition are described and in ch.6 experimental results in the LRO state are presented and discussed. 75 references, 51 figures, 3 tables.

17324 (INIS-mf—11013) **NMR of dielectrically oriented molecules. A multinuclear approach.** Ruessink, B.H. (Vrije Univ., Amsterdam (Netherlands)). 9 Oct 1986. 187p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700220/JAW.

General information on experimental aspects of EFNMR is given. It is shown that the complete ^{14}N quadrupole tensor (qct) of pyridine and pyrimidine in the liquid state is accessible to EFNMR. Information obtained about ^{17}O qct in liquid nitromethane, is compared with results from other techniques. The ^{33}S qct in liquid sulfolane is investigated. The EFNMR results, combined with those from spin-lattice relaxation time measurements and from Hartree-Fock-Slater MO calculations, allowed the complete assignment of the ^{33}S qct. The quadrupole coupling of both ^{10}B and ^{11}B in a carborane compound is investigated and, together with the results of spin-lattice relaxation time measurements, detailed information about the assignment of the boron qct's could be derived. EFNMR studies of apolar molecules are described. A limitation in EFNMR is the inhomogeneity (delta B) of the magnetic field, which is introduced by the use of non-spinning sample cells. A way out is the detection of zero quantum transitions, their widths being independent of delta B. The results and prospectives of this approach are shown for the simple three spin 1/2 system of acrylonitrile in which the small dipolar proton-proton couplings could be revealed via zero quantum transitions. 235 references, 40 figures, 16 tables.

17325 (INIS-mf—11023) **Neutron scattering studies of density fluctuations in liquid argon and neon.** Well, A.A. van. (Technische Univ. Delft (Netherlands)). 5 Sep 1985. 147p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700230/JAW.

Coherent dynamic structure factors S(k,ω) obtained by means of thermal neutron inelastic scattering are presented. The experiments were performed on liquid ^{36}Ar at four densities along the 120-K isotherm covering a range of wave numbers k from 4.2 to 39.0 nm^{-1}. The neutron time-of-flight spectra are corrected for all known experimental effects with an improved data-reduction system. Special attention is paid to corrections for multiple scattering, duty-cycle overlap, and instrumental resolution. The importance of various correction steps is shown. The reliability of the corrected data is assessed by means of two independent consistency checks, viz., the detailed-balance condition and the first frequency moment of S(k,ω). The S(k,ω) data are presented both as a function of k at fixed ω and as a function of ω at fixed k. The peak height and full width at half maximum of S(k,ω) at fixed k are shown for all densities together with the small-k (hydrodynamic) and large-k (free-gas) asymptotes. The frequency moments of S(k,ω), evaluated up to the fourth moment, are consistent with results from computer simulations and from theoretical calculations. The longitudinal current correlation function C/sub l/(k,ω), derived from the experimental S(k,ω), is examined and both its peak position (yielding the dispersion curve for longitudinal current fluctuations) and its peak height (a measure of the life time of the fluctuations) are discussed. 122 references, 49 figures, 17 tables.

17326 **(INIS-mf—11025) Studies on atom-metal interactions.** Geerlings, J.J.C. (Amsterdam Univ. (Netherlands)). 18 Mar 1987. 98p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700232/JAW.

This thesis describes a study on atom-metal interactions. In particular, resonant electron exchange in collisions between atoms or ions and a metal surface is studied experimentally. Experiments are discussed, which can be interpreted in terms of the semi-classical theory, on H^- and Li^- formation by scattering an H^+ and Li^+ beam from a cesium covered tungsten (110) surface. The primary energies range from 50 to 3000 eV. The negative ion formation probabilities are a function of both the velocity component of the scattered particles normal and parallel to the surface. It is shown that the effect of the parallel velocity is an excitation of the Fermi distribution, analogous to the thermal excitation. Experimental evidence is given that the H^- formation probabilities decrease sharply if hydrogen is adsorbed on the cesiated surface. This decrease cannot be attributed to a change in the surface work function. A model is presented to account for this. The neutralization of alkali ions scattered from a cesium covered tungsten (110) surface is also studied. 121 references, 20 figures, 1 table.

17327 (INIS-SU—431, pp 412) **Oscillations of electronuclear reactions in a crystal.** Filimonov, Yu.M.; Pivovarov, Yu.L. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17328 **(IRI—132-82-06) Short wavelength sound modes in liquid argon.** Schepper, I.M. de; Verkerk, P.; Well, A.A. van; Graff, L.A. de. (Interuniversitair Reactor Inst., Delft (Netherlands)). Dec 1982. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700248/JAW.

Neutron scattering experiments on liquid argon show evidence for the existence of sound waves with wavelengths comparable to the size of the atoms. The dynamic structure factor can be described in terms of Rayleigh and Brillouin lines. The sound oscillation frequency shows an anomaly consistent with the mode coupling theory. The shape of the dispersion curve resembles that of solid argon except for a wavelength region where the oscillation frequency vanishes as predicted by kinetic theory. 15 references, 1 figure.

17329 **(JINR—14-86-823) Hyperfine interactions for / sup 181/Ta nuclei in the Laves phases LuFe/sub 2/ and GdFe/sub 2/.** Aksel'rod, Z.Z.; Komissarova, B.A.; Krylov, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701138/JAW.

The hyperfine magnetic fields, B/sub hf/, for the Ta probe nucleus in the cubic Laves phases LuFe/sub 2/ and GdFe/sub 2/ have been measured by the TDPAC method on the 133-482 keV γ-ray cascade in /sup 181/Ta. For LuFe/sub 2/ the value of B/sub hf/=-20.5(4)T at 300 K has been obtained. For the samples of GdFe/sub 2/ prepared at low and high (7.7 G Pa) pressure the values B/sub ht//sup (1)/=+19.0(5)T and B/sub hf//sup (2)/=+10.2(4)T, consequently, have been obtained at 300 K. The observed differences in the values of B/sub hf(sup ')s/ and their temperature dependences indicate at the formation of a metastable magnetic state in GdFe/sub 2/ under the influence of high pressure. 15 refs.; 8 figs.; 4 tabs.

17330 **(LBL—23875) Solving complex and disordered surface structures with electron diffraction.** Van Hove, M.A. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 35p. (CONF-8708195—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003863/JAW.

From 8. international summer institute in surface science; Milwaukee, WI, USA (17 Aug 1987).

The past of surface structure determination with low-energy electron diffraction (LEED) will be briefly reviewed, setting the stage for a discussion of recent and future developments. The aim of these developments is to solve complex and disordered surface structures. Some efficient solutions to the theoretical and experimental problems will be presented. Since the theoretical problems dominate, the emphasis will be on theoretical approaches to the calculation of the multiple scattering of electrons through complex and disordered surfaces. 49 refs., 13 figs., 1 tab.

17331 **(LBL—24418) NMR with generalized dynamics of spin and spatial coordinates.** Lee, Chang Jae. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 235p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88005327/JAW.

This work is concerned with theoretical and experimental aspects of the generalized dynamics of nuclear spin and spatial coordinates under magnetic-field pulses and mechanical motions. The main text begins with an introduction to the concept of "fictitious" interactions. A systematic method for constructing fictitious spin-1/2 operators is given. The interaction of spins with a quantized-field is described. The concept of the fictitious interactions under the irradiation of multiple pulses is utilized to design sequences for selectively averaging linear and bilinear operators. Relations between the low-field sequences and high-field iterative schemes are clarified. These relations and the transformation properties of the spin operators are exploited to develop schemes for heteronuclear decoupling of multi-level systems. The resulting schemes are evaluated for heteronuclear decoupling of a dilute spin-1/2 from a spin-1 in liquid crystal samples and from a homonuclear spin-1/2 pair in liquids. A relation between the spin and the spatial variables is discussed. The transformation properties of the spin operators are applied to spatial coordinates and utilized to develop methods for removing the orientational dependence responsible for line broadening in a powder sample. Elimination of the second order quadrupole effects, as well as the first order anisotropies is discussed. It is shown that various sources of line broadening can effectively be eliminated by spinning and/or hopping the sample about judiciously chosen axes along with appropriate radio-frequency pulse sequences.

17332 (NEI-NO—30, pp 25) **Modelling of geometry and processes in random media using microparticles.** Skjeltorp, A.T. (Institute for Energy Technology, Kjeller, Norway). 1986. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751203/JAW. (CONF-8609372—).

From Seminar on reservoir description and simulation with emphasis on EOR; Oslo, Norway (3 Sep 1986).

Co-sponsored by Scientific Software-Intercomp, London (UK).

Colloidal dispersions of uniformly shaped spherical and non-spherical mm-sized particles are used for two-dimensional modelling of: porous materials (random to crystalline packing); growth of aggregates, dendrites and faceted crystals; physical processes in porous materials like crystal growth, fracturing diffusion and granu-

lar and fluid flow. Direct microscopic observations are analyzed using digital image processing. The patterns of the structures and processes may be described using polyhedral analysis, positional and directional order parameters and fractal measures. Selected examples are presented and compared with theoretical models and computer simulations. A film has been produced from direct microscopic observation to illustrate the various processes. 24 refs., 16 figs.

17333 (RAL—86-088) Eddy current seminar, 24-26 Mar 1986. Emson, C.R.I. (ed.). (Rutherford Appleton Lab., Chilton (UK)). Jun 1986. 225p. (CONF-8603116—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750883/JAW.

From 4. eddy current seminar; Chilton, UK (24 Mar 1986).

The paper concerns the Eddy Current Seminars, held at the Rutherford Appleton Laboratory, United Kingdom, March 1986. Twenty two papers were presented on eddy current phenomena, and two of the papers are indexed separately. The first deals with a finite difference scheme for time dependent eddy currents in Tokamaks, the second is an analysis of the FELIX experiments with cantilevered beams and hollow cylinders.

17334 (RAL—86-110) μSR spectroscopy on free radicals: a complement to ESR spectroscopy. Cox, S.F.J.; Symons, M.C.R. (Rutherford Appleton Lab., Chilton (UK)). Dec 1986. 17p. (CONF-8606134—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750946/JAW.

From 4. international conference on muon spin rotation, relaxation and resonance; Uppsala, Sweden (23 Jun 1986).

The paper on "μSR spectroscopy on free radicals" was presented to the conference on "Muon spin, rotation, relaxation and resonance" Uppsala, 1986. The spectroscopic techniques for both ESR and μSR are described, along with the interpretation of the spectra, hyperfine coupling constants and radical structure. A comparison of ESR and μSR data is carried out with respect: to 1) isotope effects in organic radicals, 2) isotope effects in solids, -the isotropic muonium defect centres, and 3) the muonium defect centres in semiconductors. Radical categories examined using ESR and μSR are discussed, including new species, formation mechanisms, and ionic species. (U.K.).

17335 (RAL—86-111) Implanted muon studies in condensed matter science. Cox, S.F.J. (Rutherford Appleton Lab., Chilton (UK)). Dec 1986. 202p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750975/JAW.

To be published in Journal of Physics C (Solid State Physics).

The paper reviews the broad range of applications of implanted muons in condensed matter. Muon spin rotation is discussed, along with the studies in magnetism, muonion, metals and organic radicals. A description of muon spin relaxation is also given, as well as techniques and applications appropriate to pulsed muon sources.

17336 (RAL—87-076) High energy neutron recoil scattering from liquid /sup 4/He. Holt, R.S.; Needham, L.M.; Paoli, M.P. (Rutherford Appleton Lab., Chilton (UK)). Oct 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751837/JAW.

The neutron recoil scattering from liquid /sup 4/He at 4.2 K and 1.6 K has been observed for a momentum transfer of 150 A/sup -1/ using the Electron Volt Spectrometer on the pulsed neutron source, ISIS. The experiment yielded mean atomic kinetic energy values <K> = 14.8 +- 3 K at 4.2 K and <K> = 14.6 +- 3.2 K at 1.6 K in good agreement with values obtained at lower momentum transfers.

17337 (RSRE-MEMO—3948) Applications of focused ion beams in microelectronics. Broughton, C.; Beale, M.I.J.; Deshmukh, V.G.I. (Royal Signals and Radar Establishment, Malvern (GB)). Apr 1986. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750950/JAW.

We present the conclusions of the RSRE programme on the application of focused ion beams in microelectronics and review the literature published in this field. We discuss the design and performance of focused beam implanters and the viability of their application to semiconductor device fabrication. Applications in the areas of lithography, direct implantation and micromachining are discussed in detail. Comparisons are made between the use of focused ion beams and existing techniques for these fabrication processes with a strong emphasis placed on the relative throughputs. We present results on a novel spot size measurement technique and the effect of beam heating on resist. We also present the results of studies into implantation passivation of resist to oxygen plasma attack as basis for a dry development lithography scheme. A novel lithography system employing flood electron exposure from a photocathode which is patterned by a focused ion beam which can also be used to repair mask defects is considered.

17338 (SAND—87-2725J) Atomic-scale simulation in materials science. Baskes, M.; Daw, M.; Foiles, S.; Dodson, B. (Sandia National Labs., Livermore, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DR00789. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005204/JAW.

State of the art techniques of atomistic simulation are discussed. Numerous examples of application to semiconductors and metals are presented. 49 refs., 5 figs., 1 tab.

17339 (SAND—87-8867) Order-disorder transition of Au and Pt (110) surfaces: The significance of relaxations and vibrations. Daw, M.S.; Foiles, S.M. (Sandia National Labs., Livermore, CA (USA)). Dec 1987. Contract AC04-76DR00789. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004651/JAW.

The Embedded Atom Method (EAM) has been combined with Monte Carlo simulations to study the structure and order-disorder transformation of Au and Pt (110) surfaces. We find that the missing row structure of Au disorders at 570°K, in close agreement with the experimental value of 650°K. For Pt, we predict a transformation at 750°K. Relaxations and vibrations are found to be essential for the accurate calculation of the critical temperature. 15 refs., 3 figs., 1 tab.

17340 (UCRL—96553-Rev.1) Why linear Birch and U/sub s/-U/sub p/ expansions work. Grover, R. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003833/JAW.

The equivalence of the Birch-Murnaghan equation to a linear U/sub s/-U/sub p/ equation was illustrated in the previous paper. Here we show in a direct manner how the virial theorem and the effect of core exclusion on valence electron kinetic energy changes lead to the convergence of the Eulerian strain expansion about the zero-pressure state. 7 refs., 4 tabs.

17341 (UCRL—96783) Fabrication and evaluation of transmissive multilayer optics for 8 keV x rays. Bionta, R.M.; Jankowski, A.F.; Makowiecki, D.M. (Lawrence Livermore National Lab., CA (USA)). 1 Dec 1987. Contract W-7405-ENG-48. 16p. (CONF-871124—21). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003999/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

We have investigated an alternative technique for fabricating zone plates that operate in the 5 to 10 keV regime. Ultimately we plan to make zone plates by sputtering alternating layers of opaque and transparent materials onto a thin wire core, then slicing perpendicular to the core axis to produce many zone plates. This technique shows promise for making x-ray optical elements that can be used in industrial crystallography, microprobe and radiography equipment. In a previous publication we reported on the favorable comparison between the measured performance of an Al/Ta diffraction grating and our numerical simulation. In this report we concentrate on the fabrication techniques used to produce diffraction gratings and linear zone plates. 2 refs., 10 figs.

17342 **Diamagnetic susceptibility of a dense electron gas.** Vignale, G.; Rasolt, M.; Geldart, D.J.W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6032). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 5, 2502-2507(15 Feb 1988). Contract AC05-84OR21400.

We calculate the diamagnetic susceptibility of a uniform interacting electron gas in the random-phase approximation. From this the exact high-density expansion of the diamagnetic susceptibility is obtained.

17343 **Molecular-orientational pinning on a surface: A simulated annealing study.** Feuston, B.P.; Ma, M.; Mahanti, S.D.; Kalia, R.K. (Department of Physics, University of Cincinnati, Cincinnati, Ohio 45221). *Physical Review* [*Section*] *A: General Physics;* **37**: No. 3, 902-910(1 Feb 1988).

Orientational properties of a quantum rotor interacting with a classical substrate are investigated by dynamical simulated annealing. At zero temperature a transition in the molecular orientation is observed when the molecule-substrate coupling exceeds a critical value α/sub c/. For very light molecules we find a smooth transition and a decrease in α/sub c/ with an increase in the moment of inertia I. Above a certain value of I the molecule undergoes a sharp reorientational transition that shifts to higher values of α/sub c/ with an increase in I. The observed continuous transition is always mean field in nature. At finite temperatures the molecule-substrate interaction has a significant thermal broadening effect on the reorientational transition. The rms fluctuations in the rotor energy increase dramatically while those in the order parameter exhibit a peak around α/sub c/.

17344 **Dimerization in the two-dimensional Hubbard model.** Zhang, F.C.; Prelovsek, P. (Theoretische Physik, Eidgenoessische Technische HochschuleHoenggerberg, 8093 Zuerich, Switzerland). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 4, 1569-1573(1 Feb 1988).

We have used both an exact diagonalization method for finite-size systems and a perturbation technique to study the lattice instability due to dimerization in a two-dimensional Hubbard model in the large-U limit. We show that a critical electron-phonon coupling strength is required to form a dimerized state, in contrast to the 1-dimensional system. Our calculations suggest the phase transition to the dimerized state is of first order. The relevance to high-T/sub c/ superconductor materials is discussed.

17345 **Columnar growth in thin films.** Mazor, A.; Srolovitz, D.J.; Hagan, P.S.; Bukiet, a.B.G. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 ience and Engineering, University of Michigan, Ann Arbor, Michigan 48109). *Physical Review Letters;* **60**: No. 5, 424-427(1 Feb 1988).

A theory for the growth of columnar microstructures in thin films is presented. The zone-I to zone-II transition temperature is predicted. The surface morphology and the columnar grain structure are obtained both analytically and numerically, and the scaling behavior of the columnar grain size with film thickness is derived. Monte Carlo simulations are used to follow the evolution of the three-dimensional zone-II microsctuctures and to account for the formation of film texture. These results agree with experimental observations.

17346 **Quasiperiodicity and long-range order in a magnetic system.** Doria, M.M.; Satija, I.I. (Theoretical Division and Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **60**: No. 5, 444-447(1 Feb 1988). Contract W-7405-ENG-36.

We study the 1D quasiperiodic quantum Ising model in a transverse field, which exhibits long-range order above a critical coupling and describes the phase diagram of the 2D classical Ising-model quasiperiodic in one direction. We numerically determine the correlation length, magnetization, and energy spectrum of this system. The site dependency of the magnetization is described by a new order parameter, the width of the magnetization. The scalings δ and f(α) associated with the Cantor spectrum are found to exhibit special features at the onset of long-range order.

17347 **Polarization dependence of magnetic x-ray scattering.** Blume, M.; Gibbs, D. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 4, 1779-1789(1 Feb 1988). Contract AC02-76CH00016.

We calculate the polarization dependence of the x-ray scattering cross section, including magnetic terms, using the Poincare representation for the polarization. General expressions are given for the polarization dependence of the cross section of the pure magnetic scattering and of the interference between charge and magnetic scattering, and for the polarization of the scattered beam in both cases. These expressions are compared to the equivalent results for magnetic neutron scattering. The general results are then specialized to several typical cases, including the scattering of linearly and circularly polarized radiation from spiral, uniaxially modulated, and ferromagnetic structures. It is shown that detailed magnetic-structure determinations are possible using synchrotron radiation. It is further demonstrated that the orbital- and spin-angular-momentum contributions of both ferromagnets and antiferromagnets may be separately measured in a variety of simple geometries. It is found that, although the efficiency is very low, linearly polarized radiation can be completely converted to circular polarization by scattering from a magnetic spiral. Finally, it is shown that, in addition to the interference between charge and magnetic scattering, there is an interference involving the spin- and orbital-angular-momentum scattering, which can couple moments in different spatial directions.

17348 **Ordering-induced changes in the optical spectra of semiconductor alloys.** Bernard, J.E.; Wei, S.; Wood, D.M.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Applied Physics Letters;* **52**: No. 4, 311-313(25 Jan 1988).

It is shown how the recently predicted and subsequently observed spontaneous long-range ordering of pseudobinary A/sub 0.5/B/sub 0.5/C isovalent semiconductor alloys into the $(AC)_1(BC)_1$ superlattice structure (a CuAuI-type crystal) gives rise to characteristic changes in the optical and photoemission spectra. We predict new direct transitions and substantial splittings of transitions absent in the disordered alloy.

17349 **Higher-order fractal geometry; application to multiple light scattering.** Seeley, G.; Keyes, T.; Ohtsuki, T. (Department of Chemistry, Boston University, Boston, Massachusetts 02215). *Physical Review Letters;* **60**: No. 4, 290-293(25 Jan 1988).

A hierarchy of fractal geometrical exponents D(l), based upon l-rank orientational fluctuations, is proposed; D(0) = D is the usual fractal dimension. The first three D(l) are calculated via computer simulation for a growth model with a tunable fractal dimension for several values in the range $3>D>1$, and for bond percolation. The new exponents are used to discuss fractal structure. The second-order light-scattering intensity is evaluated for the growing fractal clusters, and is shown to be sensitive to the higher order D(l).

17350 **Absolute determination of surface core-level emission for Ge(100)-(2 x 1) and Ge(111)-c(2 x 8): Surface reconstruction and defects.** Rich, D.H.; Miller, T.; Chiang, T. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Physical Review Letters;* **60**: No. 4, 357-360(25 Jan 1988). Contract AC02-76ER01198.

The number of surface atoms on Ge(100)-(2 x 1) and Ge(111)-c(2 x 8) which contribute to the Ge 3d core shift is determined by a combination of synchrotron photoemission, high-energy electron diffraction, and molecular-beam epitaxy techniques. The result is 0.87 +- 0.09 monolayer for Ge(100)-(2 x 1), revealing that the buckled dimer bond is primarily covalent in nature. The Ge(111)-c(2 x 8) surface shows "adatom" emission corresponding to 0.33 +- 0.04 monolayer; the departure from the ideal value of 0.5 monolayer is attributed to a large number of defects on the surface.

17351 **Supersymmetry and double-well potentials.** Keung, W.; Kovacs, E.; Sukhatme, U.P. (Department of Physics, University of Illinois at Chicago, Chicago, Illinois 60680). *Physical Review Letters;* 60: No. 1, 41-44(4 Jan 1988).

The ideas of supersymmetric quantum mechanics are applied to the tunneling problem for double-well potentials. We evaluate the tunneling by developing a systematic perturbation expansion whose leading term is an improvement over the standard WKB result. We find that the perturbation series converges rapidly.

17352 **Comment on the missing bond-charge repulsion in the extended Hubbard model.** Gammel, J.T.; Campbell, D.K. (Center for Nonlinear Studies and Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* 60: No. 1, 71-71(4 Jan 1988).

A Comment on the Letter by S. Kivelson et al., Phys. Rev. Lett. 58, 1899 (1987).

17353 **Finite-temperature behavior of the Anderson lattice.** Brandow, B.H. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* 37: No. 1, 250-260(1 Jan 1988).

At finite temperature the picture of renormalized-hybridization quasiparticle bands, obtained by various formalisms at T = 0, is shown to be inadequate in several respects. The most significant refinement recognizes the existence of a new type of elementary excitation, which simply creates (i.e., unbinds or unscreens) a local moment at an arbitrary lattice site. These excitations explain the continuous crossover between the contrasting T<<T/sub K/ and T>>T/sub K/ behaviors. They also explain the surprisingly rapid weakening, with increasing T, of inelastic peaks in neutron scattering. The concept of "coherence" is clarified. Numerical results are presented for entropy, specific heat, average valence, magnetic susceptibility, and inelastic neutron scattering.

17354 **Simple exact test for well-known molecular dynamics algorithms.** Venneri, G.D.; Hoover, W.G. (Department of Applied Science, University of California at Davis-Livermore and Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Computational Physics;* 73: No. 2, 468-475(Dec 1987). Contract W-7405-ENG-48.

The common algorithms used in molecular dynamics calculations to numerically solve the equations of motion are evaluated. (AIP) copyright 1987 Academic Press, Inc.

17355 **Exponential decay of connectivities in the two-dimensional Ising model.** Chayes, J.T.; Chayes, L.; Schonmann, R.H. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14853 Mathematical Sciences institute, Cornell University, Ithaca, New York 14853). *Journal of Statistical Physics;* 49: No. 3, 433-445(Nov 1987).

We prove some results concerning the decay of connectivities in the low-temperature phase of the two-dimensional Ising model. These provide the bounds necessary to establish, nonperturbatively, large-deviation properties for block magnetizations in these systems. We also obtain estimates on the rate at which the finite-volume, plus-boundary-condition expectation of the spin at the origin converges to the spontaneous magnetization.

6561 Superconductivity

REFER ALSO TO CITATION(S) 14738, 14908, 14983, 15033, 15060, 15070, 15071, 15072, 15073, 15077, 15087, 15101, 15108, 15112, 15114, 15115, 15117, 15118, 15119, 15120, 15122, 15123, 15124, 15125, 15133, 15134, 15139, 15140, 15141, 15142, 15146, 15149, 15150, 15151, 15152, 15153, 15154, 15156, 15157, 15158, 15208, 15311, 15338, 15769

17356 **(ENEA-RT-FUS—85-11) Resonant modes in Josephson structures.** Paterno, G. (ENEA, Rome (Italy)). 1985. 41p. (CONF-8509232—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701267/JAW.

From Conference on Josephson effect: achievements and trends; Torino, Italy (16 Sep 1985).

It is well-know that a Josephson junction held at finite voltage V generates an alternating current at a frequency *o=(2e/h)V. When the junction is coupled to an external resonator self-induced dc current modes occur in the structure. The nonlinear interaction with the ac Josephson radiation gives rise to current singularities at voltages corresponding to the resonance frequencies of the resonator. These resonances appear in the dc current voltage characteristics as current singularities. They are due to a conversion of dc power to ac power that in turn is internally dissipated. In a tunneling junction the resonator is formed of the two superconducting electrodes separated by the oxide layer. In a two junctions interferometer the resonant structure is formed of the loop inductance and the junction capacitances. A good knowledge of the behaviour of these singularities is very important when switching properties are considered or ac power has to be extracted from the structure. In this paper we review the behaviour of resonant modes in Josephson junctions coupled to a resonant structure. A comparison between experimental data and the theoretical description at present available is reported. 39 refs.

17357 **(SAND—87-2273C) An electron spectroscopic investigation of high-temperature superconducting oxides.** Rogers, J.W. Jr.; Blair, D.S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 14p. (CONF-871178—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003807/JAW.

From Thin film processing and characterization of high temperature superconductors; Anaheim, CA, USA (6 Nov 1987).

High resolution X-ray Photoelectron and X-ray-excited Auger Electron Spectroscopy (XPS and XAES) have been used to study the electronic structure of La-Sr-Cu and Y-Ba-Cu superconducting oxide surfaces. The experiments were carried out on freshly cleaved (ex-situ) samples at room temperature and the results were compared with spectra obtained from Cu and CuO. The XPS Cu(2p) features show clearly that Cu^{+2} ($3d^9$) is present in the near surface region of both superconducting oxides and suggests that they are mixed valent containing both $3d^9$ and $3d^{10}$ contributions. No evidence for Cu^{+3} ($3d^8$) was found. XAES Cu(LMM) spectral features are consistent with the superposition of mixed valent Cu sites and the hole-hole interaction energies for the Cu(LMM) transitions, a direct experimental measurement of electron correlation in the Cu 3d levels, indicate strong electron correlation. 15 refs., 3 figs.

17358 **Current distributions of thermal switching in extremely underdamped Josephson junctions.** Silvestrini, P.; Liengme, O.; Gray, K.E. (Instituto di Cibernetica del Consiglio Nazionale delle Ricerche, Via Toiano 6, 80072 Arco Felice, Napoli, Italy). *Physical Review [Section] B: Condensed Matter;* 37: No. 4, 1525-1531(1 Feb 1988).

The first measurements of the switching current distribution of an extremely underdamped Josephson junction are presented at various temperatures. Careful fitting of the data provides an experimental verification of the thermal activation theory in the very low damping limit. Moreover, the fitting allows us to obtain the "effective" resistance of a Josephson tunnel junction, thus providing an important indication as to the proper junction resistance to be used in the resistively shunted junction model. These values of junction resistance show the temperature dependence of a subgap resistance, i.e., exp(Δ/k/sub B/T), due to activation of quasiparticles over the superconductor energy gap Δ.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 15021, 16293, 16532, 16725, 16747, 16755, 17190, 17351

17359 **(CBPF-NF—012/87) Connection between general observers and Lanczos potential.** Novello, M.; Velloso, A.L. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700139/JAW.

Some algorithms to find the explicity form of Lanczos potential in an arbitrary geometry are presented.

17360 **(CBPF-NF—013/87) Experimental analysis of absolute space-time Lorentz theories.** Maciel, A.K.A.; Tiomno, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700140/JAW.

Experiments designed to test Special Relativity are reviewed and their capabilities of distinguishing Special Relativity from Absolute Space-Time theories are analysed. Of two specific forms of Absolute theories proposed in recent years, it is shown that one is refuted by past experiments while the other is still in contention.

17361 **(DOE/ER/40048—205-L7) Velocity reversal and the arrows of time.** Cramer, J.G. (Washington Univ., Seattle (USA). Dept. of Physics). 1987. Contract AC06-81ER40048. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004237/JAW.

A gedankenexperiment is proposed for distinguishing between two models accounting for the macroscopic arrow of time. The experiment involves the velocity reversal of components of an isolated system, and the two models give contrasting predictions as to its behavior. 7 refs., 1 fig.

17362 **(DOE/ER/40048—206-L7) An overview of the transactional interpretation of quantum mechanics.** Cramer, J.G. (Washington Univ., Seattle (USA). Dept. of Physics). [1987]. Contract AC06-81ER40048. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004236/JAW.

We summarize the transactional interpretation of quantum mechanics (TI) and consider various points concerning the TI and its relation to the Copenhagen interpretation (CI). Questions concerning mapping the TI onto the CI, of advanced waves as solutions to proper wave equations, of collapse and the QM formalism, and of the relation of quantum mechanical interpretations to experimental tests and results are discussed. 12 refs.

17363 **(EFI—914(65)-86) Polarization of electrons in an electromagnetic wave field in the presence of magnetic field.** Melikyan, R.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700169/JAW.

The possibility of electrons polarization in the field of circularly polarized electromagnetic wave at its propagation along the direction of constant homogeneous magnetic field discussed for the case of small transverse and large longitudinal momenta of electrons. It is shown that for large values of the wave intensity, definite direction of wave propagation as well as definite values of the ratio of wave cyclotron frequences, the effect of electron beam polarization can be obtained during several periods of electron revolution in the transverse plane without notable charge in transverse dimensions of the beam. 9 references.

17364 **(IFUSP-P—617) Unitarity defect of the s-matrix and the underlying absorptive potential II: the case of energy-dependent optical potentials.** Hussein, M.S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700188/JAW.

The unitarity defect relation involving <k'-vector[S^+ S-1]k-vector> on the one hand and the matrix element <psi$^+$/sub k-vector/ [U-U^+]psi$^+$/sub k-vector/> on the other, derived recently by Hussein, is extended here to energy-dependent interactions. This is accomplished through the introduction of two equivalent-energy-independent potentials connected with the outgoing and ingoing wave boudary conditions.

17365 **(IFUSP-P—621) Van Kampen waves in extended Fermi systems and the Random phase approximation.** Nemes, M.C.; Toledo Piza, A.F.R. de; Providencia, J. da. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jan 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700189/JAW.

An orthogonal and complete set of solutions (in the sense of the Random Phase Approximation) to the linearized Vlasov equation for an infinite, homogeneous many-fermion system is constructed classical analogues of the RPA quasiboson operators are obtained and compared to their quantum mechanical counterparts written in a classical phase-space representation. The initial value problem of determining the subsequent time evolution of a given disturbance of the (stable) equilibrium distribution is discussed.

17366 (INIS-BR—748, pp 77) **Parastatistic unified treatment of an ideal gas.** Sousa Vieira, M. da C. de; Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17367 (INIS-BR—748, pp 78) **Critical behavior of charged Bose-Einstein gas in a magnetic field in D-dimensions.** Silva, M.S.; Frota, H.O. da. 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17368 (INIS-BR—748, pp 82) **Kinetic theory of polyatomic dense gases.** Kremer, G.M. (Parana Univ., Curitiba, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

17369 **(INIS-BR—870) Study of the neutrino-gravitation interaction.** Soares, I.D. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1976. 183p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700204/JAW.

A study of the neutrino-gravitation interaction is made in the framework of Einstein-Dirac coupled equations. Two classes of solutions are obtained, corresponding to two specific physical situations. One cosmological model with expansion is obtained, having neutrinos as the only curvature source; their properties and the parameters which can to characterize the solution as a cosmological model are studied. The second class of solutions corresponds to a naive complete model of a spherically symmetric star emitting neutrinos: the inner region is suposed to be built up of a spherically symmetric distribution of a perfect fluid, bounded in space and which emitts neutrinos; the star matter is considered transparent for neutrinos; the outer region contains only neutrinos and gravitational field. The problem of neutrino compatibility with spherically symmetric gravitational fields is examined. The local conservation laws and the function conditions of the inner and outer solutions in the fluid surface are studied and permit to characterize two kinds of solutions. In one case, the solution describes the neutrino emission phase, with consequent configuration contraction, immediately before the fluid to be completely contained in the interior of the schwarzchild radius, when the neutrino emission and the star contraction stop. The other possibility can correspond to a quasi-stationary configuration, with neutrino emission, where the relativistic equation of radiative equilibrium permits to define the equivalent of Radiation pressure for neutrinos, which acts in the same sense of the gravitational pressure.

17370 (INIS-SU—431, pp 184) **To perturbation theory (PT) for degenerate states.** Polikanov, V.S. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

17371 **(LA-UR—87-4119) Antimatter: Its history and its properties.** Nieto, M.M.; Hughes, R.J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 22p. (CONF-8710125—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004308/JAW.

From 2. review and planning workshop on antiproton science and technology; Santa Monica, CA, USA (6 Oct 1987).

We review the conceptual developments of quantum theory and special relativity which culminated in the discovery of and understanding of antimatter. In particular, we emphasize how quantum theory and special relativity together imply that antimatter must exist. Our modern understanding of antimatter is summarized in the CPT theorem of relativistic quantum field theory. The implications of this theorem have never been contradicted by any experiment ever done. 38 refs.

17372 **(N—88-12979) High resolution finite volume methods on arbitrary grids via wave propagation. Final report.** Leveque, R.J. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Oct 1987. 30p. (NASA-CR—178397; ICASE—87-68; NAS—1.26:178397). NTIS, PC A03/MF A01.

A generalization of Godunov's method for systems of conservation laws has been developed and analyzed that can be applied with arbitrary time steps on arbitrary grids in one space dimension. Stability for arbitrary time steps is achieved by allowing waves to propagate through more than one mesh cell in a time step. The method is extended here to second order accuracy and to a finite volume method in two space dimensions. This latter method is based on solving one dimensional normal and tangential Riemann problems at cell interfaces and again propagating waves through one or more mesh cells. By avoiding the usual time step restriction of explicit methods, it is possible to use reasonable time steps on irregular grids where the minimum cell area is much smaller than the average cell. Boundary conditions for the Euler equations are discussed and special attention is given to the case of a Cartesian grid cut by an irregular boundary. In this case small grid cells arise only near the boundary, and it is desirable to use a time step appropriate for the regular interior cells. Numerical results in two dimensions show that this can be achieved.

17373 **(RAL—86-074) Towards a geometric formulation of the heterotic string low energy effective action.** Daniel, M.; Hochberg, D.; Mavromatos, N.E. (Rutherford Appleton Lab., Chilton (UK)). Jul 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750825/JAW.

The tree level four-point scattering amplitude for gravitons and dilatons in the heterotic string theory is examined and the structure of the most general effective Langrangian which reproduces this amplitude is discussed. This Langrangian, to leading order in $(\alpha')^3$, is quartic in a generalized curvature two-form which contains the dilaton contributions, and is constructed with conformally rescaled vielbeins and tensors invariant in the tangent space, as well as the Hodge dual operator. The full equations of motion are derived and implications for the compactification of the ten-dimensional spacetime are discussed in the context of a general ansatz.

17374 **(RAL—86-075) Cosmological constant, non-compact symmetries and Weyl invariance.** Aguila, F. del; Coughlan, G.D. (Rutherford Appleton Lab., Chilton (UK)). Jul 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750915/JAW.

The vanishing of the cosmological constant is in principle unrelated to the presence of non-compact symmetries. Obvious exceptions appear to be unrealistic.

17375 **(RRK—87-17) On a possibility that Kantowski-Sach's 4-space may be conformal to ours.** Nariai, Hidekazu. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Aug 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752001/JAW.

A possibility that Kantowski-Sach's-like 4-space may be conformal to Nariai's vacuum 4-space with a positive cosmological constant and the S tiled/sub 2/ x S/sub 2/ - topology is studied. It is shown that the former 4-space is enevitably to the latter 4-space.

17376 **(RRK—87-19) One-loop mass shifts in O(32) open superstring theory.** Yamamoto, Hisashi. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Aug 1987. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752003/JAW.

One-loop amplitudes of O(N) open superstring with emission of massive bosons are studied. Divergences appearing at $\lambda = 0$ (λ: the over-all Teichmueller parameter) are shown to be canceled if N = 32 just as in the massless case. We explicitly evaluate the two-point on-shell amplitudes for all the levels of bosons lying on the leading (m/sup 2/ = 2 l, J = l + 1, m:mass J:spin l:level number of an excited state) and the next-to-leading (m/sup 2/ = 2 l, J = l) Regge trajectories and observe that they are nonvanishing even at N = 32. This implies that O(32) open super-string one-loop amplitudes with massive bosons generally suffer from external-line divergences. Further the obtained expressions of on-shell self energies (mass shifts δm/sup 2/(l)) seem to have nontrivial dependences on l (being not proportional to l), although mass degeneracies remain. This strongly suggests that the Regge trajectories form a set of parallel polygonal lines at one-loop level so that the mass shifts cannot be absorbed by the shift of the slope parameter. The divergences would have to be cured by the vertex operator renormalizations at every excited level.

17377 **(SLAC-PUB—3805) Quantum density matrix and entropic uncertainty.** Blankenbecler, R.; Partovi, M.H. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); California State Univ., Sacramento (USA). Dept. of Physics). Jul 1985. Contract AC03-76SF00515. 12p. (CONF-8508253—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004906/JAW.

From 5. workshop on maximum entropy and Bayesian methods in applied statistics; Laramie, WY, USA (5 Aug 1985).

A discussion of the determination of the quantum density matrix from realistic measurements using the maximum entropy principle is presented. 3 refs.

17378 **(UCRL—96552) Numerical simulation of the propagation and absorption due to air breakdown of long microwave pulses.** Sieger, G.E.; Mayhall, D.J.; Yee, J.H. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 12p. (CONF-871093—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005227/JAW.

From 8. international workshop on laser interaction and related plasma phenomena; Monterey, CA, USA (27 Oct 1987).

In order to calculate the propagation of long microwave pulses in air, we have developed a steady-state fluid code, in which the electric field is a time-harmonic wave whose amplitude and frequency are allowed to vary slowly in time. The method of calculation makes use of the assumption that at each position and time the electron fluid is equilibrated at the local field amplitude and frequency.

17379 **3D transient eddy current fields using the u-v integral-eigenvalue formulation.** Davey, K.R.; Han, H.C.; Turner, L. (School of Electrical Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332-0250). *Journal of Applied Physics;* 63: No. 4, 991-996(15 Feb 1988).

The three-dimensional eddy current transient field problem is formulated using the u-v method. This method breaks the vector Helmholtz equation into two scalar Helmholtz equations. Null field integral equations and the appropriate boundary conditions are used to set up an identification matrix which is independent of null field point locations. Embedded in the identification matrix are the unknown eigenvalues of the problem representing its impulse response in time. These eigenvalues are found by equating the determinant of the identification matrix to zero. When the initial transient forcing function is Fourier decomposed into its spatial harmonics, each Fourier component can be associated with a unique eigenvalue by this technique. The true transient solution comes through a convolution of the impulse response, so obtained with the particular external field decay governing the problem at hand. The technique is applied to the FELIX (fusion electromagnetic induction experiments) medium cylinder experiment; computed results are compared with data. A pseudoanalytic confirmation of the eigenvalues so obtained is formulated to validate the procedure.

17380 **Driven Morse oscillator: Classical chaos, quantum theory, and photodissociation.** Goggin, M.E.; Milonni, P.W. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* 37: No. 3, 796-806(1 Feb 1988).

We compare the classical and quantum theories of a Morse oscillator driven by a sinusoidal field, focusing attention on multiple-photon excitation and dissociation. In both the classical and quantum theories the threshold field strength for dissociation may be estimated fairly accurately on the basis of classical resonance overlap, and the classical and quantum results for the threshold are in good agreement except near higher-order classical resonances and quantum multiphoton resonances. We discuss the possibility of "quantum chaos" in such driven molecular systems and use the Morse oscillator to test the manifestations of classical resonance overlap suggested semiclassically.

17381 **Construction of B/sup //sup (1)//sub //sub 1/ in terms of vertex operators and a Lie-admissible not associative algebra.** Cougo-Pinto, M.V. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Journal of Mathematical Physics (New York);* 29: No. 2, 275-280(Feb 1988).

The affine nontwisted Kac—Moody algebra B/sup (1)//sub 1/ is constructed in terms of an underlying not associative algebra obtained by tensoring an associative algebra of vertex operators with a given Lie-admissible algebra. The former has its origin in bosonic string theory and the latter is found to be essentially an algebra of contractions used in canonical field theory.

17382 **Duals and propagators: A canonical formalism for nonlinear equations.** Cacuci, D.G.; Perez, R.B.; Protopopescu, V. (Oak Ridge National Laboratory, Engineering Physics and Mathematics Division, Oak Ridge, Tennessee 37831). *Journal of Mathematical Physics (New York);* 29: No. 2, 353-361(Feb 1988). Contract AC05-84OR21400.

A new formalism for solving general nonlinear equations is proposed. Given a nonlinear operator equation, a dual operator is constructed, canonically, similar to the adjoint operator in linear theory. By using this dual operator, advanced and retarded propagators (analogs of the Green's functions in linear theory) are generated. These propagators satisfy the customary reciprocity and semigroup properties and yield the formal solution of the original nonlinear problem. It is further shown that these propagators can be obtained either by solving a linear equation that still contains an implicit dependence on the problem's solution or by solving a closed-form nonlinear integral equation from which the problem's solution itself is completely eliminated. The formalism is canonical in the sense that its applicability is not affected by the particularities of the nonlinear operator, boundary conditions, and underlying phase space. All aspects of applying this formalism to nonlinear problems are illustrated analytically on the Riccati equation.

17383 **Driven three-state model and its analytic solutions.** Carroll, C.E.; Hioe, F.T. (Department of Physics, St. John Fisher College, Rochester, New York 14618). *Journal of Mathematical Physics (New York);* 29: No. 2, 487-509(Feb 1988).

For an atom or molecule in which two transitions are driven by laser beams, a three-state model is used. Transitions among the three states are caused only by the oscillating electric fields of the laser beams. The amplitudes and detunings of the two laser beams, which are various functions of the time, appear in the Schroedinger equation for the atom or molecule. In certain cases, the Schroedinger equation can be solved analytically, to find transition probabilities and the probability of no transition. This is done by using Clausen's special function, or by assuming that the sum of the two detunings is zero at all times. Conditions for complete transfer of the population from the ground state to an excited state are obtained from the analytic solutions.

17384 **Geometrical phases from global gauge invariance of nonlinear classical field theories.** Garrison, J.C.; Chiao, R.Y. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review Letters;* 60: No. 3, 165-168(18 Jan 1988). Contract W-7405-ENG-48.

We show that the geometrical phases recently discovered in quantum mechanics also occur naturally in the theory of any classical complex multicomponent field satisfying nonlinear equations derived from a Lagrangean with is invariant under gauge transformations of the first kind. Some examples are the paraxial wave equation for nonlinear optics, and Ginzburg-Landau equations for complex order parameters in condensed-matter physics.

17385 **Reversible mechanics and time's arrow.** Hoover, W.G. (Department of Applied Science, University of California at DavisLivermore, Livermore, California 94550). *Physical Review* [*Section*] *A: General Physics;* 37: No. 1, 252-257(1 Jan 1988).

The microscopic mechanics discovered by Nose, of which Gauss's isokinetic mechanics is a special case, makes it possible to simulate macroscopic irreversible nonequilibrium flows with purely reversible equations of motion. The Gauss-Nose and Nose-Hoover equations of motion explicitly include time-reversible momentum and energy reservoirs. Computer simulations of nonequilibrium steady-state systems described by Gauss-Nose mechanics invariably evolve in such a way as to increase entropy. The corresponding phase-space distribution functions, which include reservoir degrees of freedom, collapse onto stable strange attractors. Hypothetical time-reversed motions, which would violate the second law of thermodynamics, cannot be observed for two reasons: First, such reversed motions would occupy zero volume in the phase space; second, they would be dynamically unstable. Thus, Nose's reversible mechanics is fully consistent with irreversible thermodynamics, in the way forecast by Prigogine. That is, the consistency follows from the formulation of new microscopic equations of motion.

17386 **Analogy between spin glasses and Yang—Mills fluids.** Holm, D.D.; Kupershmidt, B.A. (Center for Nonlinear Studies and Theoretical Division, MS B284, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Mathematical Physics (New York);* 29: No. 1, 21-30(Jan 1988).

A dictionary of correspondence is established between the dynamical variables for spin-glass fluid and Yang-Mills plasma. The Lie-algebraic interpretation of these variables is presented for the two theories. The noncanonical Poisson bracket for the Hamiltonian dynamics of an ideal spin glass is shown to be identical to that for the dynamics of a Yang—Mills fluid plasma, although the Hamiltonians differ for the two theories. This Poisson bracket is associated to the dual space of an infinite-dimensional Lie algebra of semidirect-product type.

17387 **Splitting methods and invariant imbedding for time-independent wave propagation in focusing media and wave guides.** Evans, J.W. (Ames Laboratory, Applied Mathematical Sciences, Iowa State University, Ames, Iowa 50011). *Journal of Mathematical Physics (New York);* 29: No. 1, 97-102(Jan 1988). Contract W-7405-ENG-82.

For time-independent wave propagation in focusing media or wave guides, backscattering and coupling between propagation modes are caused by deterministic or random variations of the refractive index in the distinguished (x) direction of propagation. Various splittings of the wave field into forward and backward traveling components, which lead to coupled equations involving abstract operator coefficients, are presented. Choosing a natural explicit representation for these operators immediately yields a coupled mode form of these equations. The splitting procedure also leads naturally to abstract transmission and reflection operators for slabs of finite thickness ($a \leq x \leq b$), and abstract invariant imbedding equations satisfied by these. The coupled mode form of these equations, together with such features as reciprocity (associated with an underlying symplectic structure) are also discussed. The example of a square law medium is used to illustrate some of these concepts.

17388 **One-dimensional hydrogen atom.** Van Siclen, C. (Physics Group, Idaho National Engineering, Laboratory, Idaho Falls, ID 83415). *American Journal of Physics;* **56**: No. 1, 9-10(Jan 1988).

A recently found degeneracy in the energy levels of the one-dimensional hydrogen atom is attributed to a hidden O(2) symmetry. (AIP)

17389 **Fermion assemblies: From collapse to saturation.** Pacheco, A.F.; Sanudo, J. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *American Journal of Physics;* **56**: No. 1, 40-44(Jan 1988).

Through a very simple analysis, the condition of stability of a fermion assembly at zero temperature will be studied. The radius of equilibrium is calculated by minimizing the energy of a uniform-density spherical distribution. Depending on the nature of the attractive force existing between the particles, the article will illustrate the different types of collapse induced in the assembly. The property of saturation when a hard core is included will also be shown. These considerations provide simple models for the atom, for the nucleus, and for gravitational clusters of fermions.

17390 **Exact Lyapunov dimension of the universal attractor for the complex Ginzburg-Landau equation.** Doering, C.R.; Gibbon, J.D.; Holm, D.D.; Nicolaenko, B. (Center for Nonlinear Studies and Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **59**: No. 26, 2911-2914(28 Dec 1987). Contract W-7405-ENG-36.

We present an exact analytic computation of the Lyapunov dimension of the universal attractor of the complex Ginzburg-Landau partial differential equation for a finite range of its parameter values. We obtain upper bounds on the attractor's dimension when the parameters do not permit an exact evaluation by our methods. The exact Lyapunov dimension agrees with an estimate of the number of degrees of freedom based on a simple linear stability analysis and mode-counting argument.

17391 **Coherent extinction and self-homodyning by small particles.** Pettit, D.R. (Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). *Applied Optics;* **26**: No. 23, 5136-5142(1 Dec 1987).

Single-particle extinction using a coherent light source and where the Van Cittert-Zernike theorem applies to the forward-scattered light requires the angular summation of scattered fields instead of scattered intensities as done in the usual incoherent calculations. In spite of this approach, the resulting signals are calculated to be indistinguishable for single particles that are held stationary in the beam. When a flowing stream of particles moves perpendicularly through the beam one at a time, a modulated signal results which is described by an optical homodyning process and is called self-homodyning. The detection limit is a factor of 10 lower than that for incoherent extinction, allowing the detection of single submicrometer particles by simple extinction measurements. Theoretical calculations predicted the minimum detectable diameter for polystyrene latex (PSL) spheres to be 0.22 μm, and experimental measurements were able to detect PSL spheres of 0.31 μm.

17392 **Lyapunov exponents and subspace evolution.** Rokni, M.; Berger, B.S. (University of Maryland, College Park, MD). *Quarterly of Applied Mathematics;* **45**: No. 4, 789-794(Dec 1987).

Differential equations are derived which describe the evolution of area tensors and normals associated with the subspaces of an n-dimensional Euclidean phase space, E/sub n/. These provide computational methods for determining the Lyapunov exponents of continuous dynamical systems.

17393 **Bifurcations of periodic trajectories in non-integrable Hamiltonian systems with two degrees of freedom: Numerical and analytical results.** de Aguiar, M.A.M.; Malta, C.P.; Baranger, M.; Davies, K.T.R. (Instituto de Fisica, Universidade de Sa-tildeo Paulo, C.P. 20516, 01498, Sa-tildeo Paulo, SP, Brazil). *Annals of Physics (New York);* **180**: No. 2, 167-205(Dec 1987).

Numerical and analytical studies of the types of period n-upling bifurcations undergone by classical periodic trajectories of non-integrable Hamiltonians with two degrees of freedom are made. The Hamiltonians studied possess time reversal and reflection symmetries and we found that these symmetries give rise to additional types of period n-upling bifurcations. The analytical study explains most of the numerically observed birfucations. copyright 1987 Academic Press, Inc.

17394 **Rates of diffusion-limited reaction in periodic systems.** Torney, D.C.; Goldstein, B. (Theoretical Biology and Biophysics, Theoretical Division, Group T-10, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Statistical Physics;* **49**: No. 3, 725-750(Nov 1987).

The pseudopotential and perturbation theory are used to derive the first three terms in the expansion of the smallest eigenvalue of the Helmholtz equation both for infinite two-dimensional systems with an array of perfectly absorbing circles centered on (1) a square lattice and (2) a triangular lattice, and also for infinite three-dimensional systems both with arrays of perfectly absorbing interspersed cylinders and with an array of perfectly absorbing spheres centered on (1), a simple cubic lattice, (2) a body-centered cubic lattice, and (3) a face-centered cubic lattice. In all cases, the perturbation parameter involves the ratio of the radius of the absorber to the lattice spacing. These eigenvalues and the corresponding eigenfunctions are used to compute the first three terms of expansions of the first passage time of a diffusing point particle randomly placed outside the absorbers. Expressing the perturbation parameter as a function of the area or volume fraction occupied by the absorbers reveals a remarkable similarity among the rates of diffusion-limited reaction for arrays of absorbers and the corresponding radially symmetric system containing one central absorber.

17395 **Role of fluctuations in nonlinear optical absorption processes.** Smith, S.J. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, CO 80309-0440). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 202-207(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

Fully quantitative experimental investigations of nonlinear optical absorption processes can only be carried out with optical fields for which higher order correlation functions are known. A technical capability for synthesizing such laser power spectra by introducing Gaussian frequency fluctuations to the external field of a well-stabilized single-mode laser has been developed and applied to double-optical-resonance measurements in atomic sodium. Experimental results agree well with predictions of a full theoretical treatment.

17396 **Parametric processes and gain saturation in resonantly enhanced optical phase conjugation in Na vapor near a two-photon resonance.** Wunderlich, R.K.; Garrett, W.R.; Payne, M.G. (Chemical Physics Section, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37831-6125). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 208-210(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

Conjugate wave generation has been studied in Na vapor near two-photon resonance with the 4D state. Measurements of reflection gain at the laser frequency, stimulated Raman scattering, amplified spontaneous emission, and parametric four-wave mixing intensities are used to delineate the role of parasitic processes in determining conjugate "reflection" gain profiles.

17397 **Observation of long-lived collision-induced coherences and ground-state-spin gratings in a flame.** Trebino, R.; Rahn, L.A. (Combustion Research Facility, Sandia National Laboratories, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 217-219(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

We observe collision-induced four-wave-mixing resonances: Zeeman and hyperfine coherences and ground-state-spin gratings: in a sodium-seeded hydrogen-air flame. We see several new characteristics of collision-induced phenomena at high intensity.

17398 **Quasiperiodic and chaotic motions in intense field multiphoton processes.** Shih-I Chu. (Department of Chemistry, University of Kansas, Lawrence, Kansas 66045). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 282-288(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

The question of the behavior of quantum systems in time-dependent fields whose classical counterparts exhibit chaotic behavior is addressed. For any nondissipative bounded quantum system under the influence of polychromatic (i.e., quasiperiodic) fields, it is proved by means of the many-mode Floquet theory that the autocorrelation function will recur infinitely often in the course of time, indicating no strict quantum stochasticity is possible. In particular, for an N-level quantum system undergoing multiphoton transitions, its dynamic behavior is described by the quasiperiodic motion of an (N^2-1)-dimensional coherence vector S-arrow-right in accord with the SU(N) dynamic symmetries. On the other hand, for any dissipative quantum system, SU(N) symmetries are broken, and non-quasiperiodic behavior is observed as the coherence vector S-arrow-right evolves from an initially (N^2-1)-dimensional space to a lower-dimensional space. The dynamical behaviors are illustrated for two- and three-level quantum systems driven by intense bichromatic laser fields.

17399 **Recursion relations for solutions to the Schrodinger equation.** Reach, M. (Dept. of Mathematics and Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). *SIAM Journal of Mathematical Analysis;* **18**: No. 2, 465-472(Mar 1987). Contract AC03-76SF00098.

The author considers the general eigenfunction for a second-order differential operator in one variable. For many well-known elementary functions, they can also find a three-term recursion relation in the eigenvalue parameter. For practical computation, this is a very desirable property. Examples include Legendre functions, Bessel functions, etc. In [Math. Z., 29 (1929), pp. 730-736], Bochner showed that the only polynomial solutions to this problem were the well-known ones. This paper looks for solutions that may not be polynomials. It is known that, unfortunately, for the simple recursion relation considered here, no really new examples exist.

17400 **Geometrical integrability and equations of motion: A unifying description of equations of motion.** Chau, L. (Physics Dept., Brookhaven National Lab., Upton, NY 11973). pp 52-75 of Particle and nuclear physics. Ning, H.; Chong-shi, W. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8509276—).

From International symposium on particle and nuclear physics; Beijing, China (2 Sep 1985).

It is pointed out that many equations of motion in physics, including gravitational and Yang-Mills equations, have a common origin: i.e. they are the results of certain geometrical integrability conditions. These integrability conditions lead to linear systems that are important in integrating these equations of motion.

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REFER ALSO TO CITATION(S) 14510

17401 **U.S. magnetic fusion program.** Decker, J.F. (U.S. Department of Energy, Wasington, DC 20545). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 1-12(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

This paper is an overview of the U.S. Magnetic Fusion Program. A new program plan, issued in February 1985, defines four key issues for fusion: developing an improved confinement system, understanding burning plasmas, materials, and nuclear technology. The implementation of the program will rely strongly on foreign collaboration. Some recent technical highlights are also presented.

17402 **U.S. inertial fusion program overview.** Schriever, R.L. (Director, Office of Inertial Fusion, U.S. Department of Energy). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 13-19(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

The status of laser and light ion beam research and development is discussed in the context of the recently completed review of the U.S. program by a committee of the National Academy of Sciences.

17403 **Standard method for economic analyses of inertial confinement fusion power plants.** Meier, W.R. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 318(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A standard method for calculating the total capital cost and the cost of electricity (COE) for a typical inertial confinement fusion (ICF) electric power plant has been developed. The purpose of standardizing the method is to facilitate consistent economic comparisons. While a set of default parameters defines a base case, it is not intended to exclude the investigation of concepts, approaches, or situations that may differ for the base case. Therefore, the description of the method is complete enough to evaluate the total capital cost and the COE for any set of conditions. The method is based on the procedures currently used for nuclear and fossil power plants.

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REFER ALSO TO CITATION(S) 14782, 15926, 16379, 16398, 16479, 16520, 16521

17404 **(CEA-CONF—9170) Nonlinear absorption in wave driven plasmas.** Rax, J.M. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Jun 1987. 6p. (CONF-870515—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751846/JAW.

From Spring college on plasma physics; Miramare, Italy (25 May 1987).

We study the saturation of the wave absorption in a radio frequency driven plasma. A critical energy above which it is useless to work is introduced. The influence of an electric field and practical consequences are then considered.